This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LANE MEDICAL LIBRARY STANFORD
J53 .M681 1882 STOR
The practitioners guide in urinalysis /
24503312621

LANE

MEDICAL LIBRARY

LEVI COOPER LANE FUND

LIBRARY

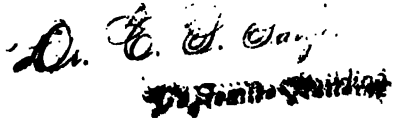
COOPER MEDICAL COLLEGE

DATE Sept 1902

NO. 5696 CLASS 8

GIFT OF

Purchase



C. L. Saylor M.D
4o Semple Bldg.
Stockton

THE

PRACTITIONERS

Guide in Urinalysis.

BY

CLIFFORD MITCHELL, A. B., M. D.,

Author of "MANUAL OF URINARY ANALYSIS," "CLINICAL SIGNIFICANCE OF THE URINE," etc.

ILLUSTRATED.

LANE LIBRARY

CHICAGO:
GROSS & DELBRIDGE.
1882.

A1

COPYRIGHT BY
GROSS & DELBRIDGE,
1882.

LANE LIBRARY

J53
M681
1882

PREFACE.

The object of the present little work is to enable the practitioner of but little experience in the use of chemicals and the microscope, to ascertain as accurately and rapidly as possible the physical characteristics of the urine, to determine its constituents, normal and abnormal, the contents of sediments, etc., etc., and after the various substances entering into the composition of the fluid have been ascertained by analysis, to teach the clinical significance of the same. With this end in view, the book is divided into two parts: I. Practical, and II. Clinical. In Part I. the methods of analyzing urine have been set forth together with the microscopical appearances of deposits, etc., in the simplest and plainest language possible. At the end of every few pages a "Clinical Summary" is given explaining in condensed and general terms the clinical significance of everything ascertained up to that point by chemical or microscopical means. The clinical hints and aids to diagnosis given in Part I. are more widely touched upon in Part II., and some little attention given to the more recent discoveries in urinary pathology. The order in which the book is written enables the hurried practitioner to find everything of the greatest consequence in routine practice in Part I.; in doubtful cases where more study and attention must be given it is hoped that Part II. may be of aid. Inasmuch as few works on the urine go into detail in describing chemical apparatus, reagents, etc., an introduction to Part I. has

been arranged in which even the simplest matters relating to the use of chemicals and the microscope have been explained. In describing chemical tests the physician may here and there find a well-known one omitted, but this has been done only where, in the author's experience as a teacher, he has seen it cause confusion. Moreover in describing tests for important abnormal constituents a simple clinical test has been given first, followed by a more thorough and conclusive one.

Chemical terms, when used, are simplified as far as possible without being actually inaccurate. Among the large number of writers from whose works and articles the author has collected his facts, he is especially indebted to Vogel and Ralfe, for aid in studying the clinical significance of urine; to Senator, who in his recent work entitled "Die Albuminurie," has discussed at considerable length the so-called "normal albumin," and to Prof. E. H. Wood, of the Harvard Medical School, for his plea in favor of the "twenty-four hours urine" in cases of Bright's disease.

Observations of the author on the daily quantity and specific gravity of normal urine as observed by him during a period of some fifty days, together with such cases in his own analytical practice as have been of especial interest to him, will be found in part Part II. (See also Appendix.)

CHICAGO, ILL.,
296 ERIE STREET,
September 1, 1882.

INTRODUCTION.

TEST-TUBES.—Most of the work to be done in examining a specimen of urine requires some familiarity with the use of *test-tubes*, Fig. 1—small glass cylinders closed at one

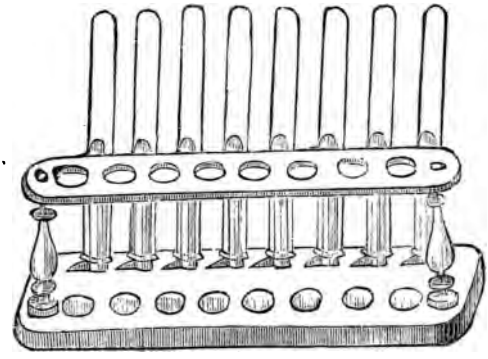


FIG. 1.

end and open at the other. Test-tubes holding one-half a fluid ounce are of convenient size in urine analysis; when filled with any liquid they should be stood in the apertures of a *test-tube rack* or *stand* (Fig. 1); when cleaned, a *test-tube brush* should be used, which is merely two wires twisted together, holding at one end a number of bristles. Test-tubes are so called from the fact that in them "tests" are conveniently made; a specimen of urine is said to be "tested" for any substance it may contain when certain processes, chemical or physical, are gone through with, with a view to ascertain whether or not the

substance be present in the urine. Thus, a "test" is said to be made for albumin when the urine, supposed to contain it, is *heated*, or when nitric acid is added, etc.

After a test has been made the test-tube which has been used should at once be cleaned; if it be not convenient for any reason to do this the tube may stand in the rack until all work of the kind has been finished, when all the test-tubes which have been used may be cleaned at one time. It is not advisable to allow urine to remain in the tubes for any length of time especially when to it have been added various reagents.

FIG. 2.

Never stand a test-tube in a cup, glass or beaker, but always in the rack.

To clean the tubes pour out the liquid contained in them, if any, rinse out with water, which if possible should be *warm*, then filling half or two-thirds full of water introduce the test-tube brush and work it to and fro carefully pushing it down to the very end of the tube. After the tubes have been washed they should be inverted over the pegs in the rack to dry.

Never use a dirty test-tube, and never perform more than one test at a time in one tube, unless particularly directed.

If the tubes cannot be thoroughly cleaned with water, try acids, ammonia, alcohol, or ether.

How to heat or boil urine.—To heat urine fill the test-tube half-full and hold over an alcohol-lamp flame gently moving the tube from side to side so as to prevent boiling; when it is necessary to boil the urine, take a strip

of paper four or five inches long, and say, half an inch wide, fold it around the tube a little above the point corresponding to the surface of the liquid inside, press the two ends of the paper tightly together keeping the tips of the thumb and forefinger against that part of the paper which envelopes the tube, then hold the tube cautiously over the flame until it boils.

It is not desirable to use a gas flame for heating or boiling urine inasmuch as the test-tube becomes covered with soot and if the flame be too strong there is danger of cracking the tube unless it be kept actively in motion.

With an alcohol-lamp flame urine can be boiled for some time without bubbling over, if due care be exercised.

In testing urine always notice whether the directions given in the "Manual" used are *to heat* or *to boil*, and if the former is specified, remove the test-tube from the flame before the first sign of ebullition.

If any reagent to be boiled, as Fehling's solution, have a tendency to "bump," i. e., suddenly and without warning to boil over, add a few fragments of an ordinary clay-pipe which must be clean and new.

TEST-GLASSES.—Next in importance to test-tubes are the glasses in which urinary sediments are collected.

To collect a sediment or deposit, allow the urine to stand at rest in a tall, narrow, cylindrical glass vessel like the one shown in Fig. 2; the best are those provided with a lip. After the deposit has settled to the bottom of the test-glass, remove the clear urine by *decantation.*

To decant urine hold the test-glass very steadily in the right hand; against the lip hold with the left hand a glass rod, grasping the latter near its upper end.

Next incline the test-glass in such a way as to pour

the urine down the rod into any vessel desired. Cease pouring the moment any of the sediment is seen to slip out.

It is well to have one test-glass which is graduated either in centimetres or fluid ounces, large enough to hold four or five of the latter and provided with a foot or base.

PIPETTES.—To examine a sediment with the microscope there is need of the little instrument called a *pipette*, which is merely a slender glass tube six to twelve inches long with an internal diameter of from $\frac{1}{10}$ to $\frac{1}{20}$ inch and drawn out to a pointed end; the use of a pipette is to transfer a drop of urine containing sediment to the glass slide used in microscopical work. After the deposit has settled to the bottom of the test-glass place the tip of the forefinger over the upper end of the pipette and dip the lower or pointed end into the sediment. Next remove the finger for an instant, then quickly close the orifice again with it. A portion of the sediment has passed into the pipette and can be held there as long as the finger is tightly pressed against the orifice in the upper end of the pipette, hence can be carried to a glass slide, when on removing the finger, the sediment will flow out.

The best pipette for collecting urinary sediments is (b) a glass tube having a calibre of one inch in diameter and a length of ten or twelve inches; one extremity is tapered off to a very small orifice and furnished with a glass stop-cock. The sediment having been obtained in a test-glass as before, decant the supernatant urine, then pour the sediment into pipette (b) and allow it to settle. Carefully open the stop-cock and a drop of the densest part of the deposit may be received on a glass slide and examined with the microscope.

It is much better to use pipette (b) than the kind mentioned first.

FILTRATION.—Before performing certain tests, as for albumin, sugar, etc., it is advisable that the urine be filtered; the apparatus essential to filtration is composed of a *funnel*, *filters* or *filter paper*, *a filter ring* and *stand* and a test-glass. Funnels are of glass and of various sizes; those three or four inches in diameter across the top are of convenient size. Filter paper is unsized and many varieties of it are manufactured; the so-called "Prat-Dumas" French filter paper comes cut in circular form in packs of 100 filters each and is the best for the physician's use. Filters having a diameter of 7½ inches are of convenient size for the funnel mentioned above. A filter ring and stand is shown in Fig. 3.

FIG. 3.

In order to filter, take one paper from the package of cut filters (or cut out from Swedish filter paper a circular piece of 7 or 8 inches in diameter), fold in two, next turn over each edge as you would two opposite leaves in a book, namely one end from right to left and the other from left to right until they just do not meet. A funnel shape is in this manner given to the paper (Fig. 4). Thus folded, place the filter into the funnel, open on the side opposite to where it was last

folded, and fit it closely down into the funnel. Do not let the paper project over the rim of the funnel and before pouring the urine into it moisten with distilled water evenly and gently from the lowest part upward. Having fitted the paper to the funnel and moistened as described, next set the funnel into the filtering-ring and place a test-glass or any glass vessel desired beneath the spout of the funnel. Now pour the urine into the funnel after the method of decantation by means of the glass rod, and when about seven-eighths full cease pouring. Observe whether the urine trickling through into the test-glass or beaker beneath the funnel be clear; if not, pour the urine in the funnel, into the test-glass, take out the filter paper, throw it away and fit a new one. Next take a clean test-glass or beaker, place it beneath the spout of the funnel, and pour the urine now contained in the first test-glass or beaker into the funnel.

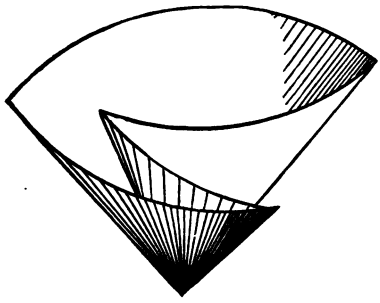


FIG. 4.

Chemical Examination of Sediment.—If it be desired to examine the sediment chemically, wait until the urine has completely filtered, remove the filter-paper, place it in a porcelain dish, make a small hole in it and wash the sediment through this hole by means of the *wash-bottle;* the latter is a flask or bottle closed with a twice perforated snugly-fitting stopper through which two glass tubes are passed, each bent above the cork, the one at an acute angle the other at an obtuse. When the bottle is filled

with water, blowing through the obtuse-angled tube will force a stream of water with considerable violence through the acute-angled tube, and any precipitate or deposit adhering to the filter paper may be washed off. Ordinarily the physician need not have recourse to this method of obtaining a sediment as decantation of the supernatant urine will answer most purposes, leaving, as it does, the sediment at the bottom of the test-glass.

GLASS JARS.—The physician should own a few half-gallon or gallon glass jars in which to collect the urine of a patient when the whole quantity for twenty-four hours is required; besides these it is convenient to have a cylindrical jar graduated in cubic centimeters or fluid ounces, capable of containing 1000 cubic centimetres (a little over a quart—two pints two fluid ounces nearly). The patient having collected the urine of twenty-four hours in one of the half-gallon jars the physician can measure the amount by one of the graduated jars.

Miscellaneous.—Besides the instruments mentioned thus far it is desirable to have three pipettes graduated in 5, 10, and 20 cubic centimetres, an alcohol lamp, three or four porcelain dishes of different sizes, a small *chemical* thermometer for taking the temperature of urine, three or four glass rods, a pair of small brass forceps, litmus paper, both red and blue, readily obtained in little books, and an urinometer and beaker (see Specific Gravity).

CHEMICAL REAGENTS.—Chemicals used in testing the urine are called reagents, the chemical processes being known as reactions.

The following are useful in urinalysis:

Nitric acid, chemically pure, kept away from light and in glass-stoppered bottle.

Hydrochloric acid, chemically pure, kept away from ammonia in glass-stoppered bottle.

Acetic acid of two kinds, (i.) pure glacial and (ii.) dilute—one part glacial to five parts distilled water, in glass-stoppered bottles.

Sulphuric acid, chemically pure, colorless, in glass-stoppered bottle.

Nitric acid, commercial, containing Nitrous acid, in glass-stoppered bottle.

Trichloracetic acid, pure in crystals, in tightly-stoppered bottle.

Ammonia, one part strongest to three parts distilled water.

Potassa, one part solid caustic potash to ten parts distilled water by weight.

Silver nitrate, one part crystals to ten parts distilled water by weight, kept from the light.

Barium chloride, solution of the same proportions as the silver nitrate.

Potassium ferrocyanide, solution of the same proportions as the silver nitrate.

Fehling's solution—described under Sugar.

Chlorinated Soda, U. S. P.—preferably Squibb's.

Alcohol, 95 per cent.

Spirits Turpentine.

Tincture Guaiac.

Ammonium molybdate in solution.

Caustic Potash, in sticks, kept in a *cork*-stoppered bottle.

Distilled water in a glass-stoppered bottle holding one quart or more.

Condensed yeast, to be bought fresh whenever needed.

CHEMICAL TERMS.—Add nitric acid, add ammonia, etc. When the term "add" is used without specifying

the amount, neither too much nor too little of the reagent should be added to the urine; if the test-tube be half full of urine fifteen to thirty drops of the reagent may be used.

Alkali, Alkaline, Alkalinity.—An alkali is a compound substance very soluble in water, turning red litmus paper blue, and opposed in its properties to the characters of sour or acid substances. The alkali most familiar to every one is *ammonia* which from its well-known tendency to evaporate is called a *volatile* alkali. Potash and soda are called on the other hand *fixed* alkalies. The urine is said to be *alkaline* when a piece of red litmus paper dipped into it is turned blue; in such a case an *alkali* of some sort is present in the urine and we speak of the *alkalinity* of the latter.

Acid, Acids, Acidity.—The sour substances called acids are of several varieties; *mineral* acids are very corrosive, generally liquid in form and have a powerful action on the skin, clothing, etc. Those used in urinary analysis are nitric, hydrochloric and sulphuric. They are corrosive poisons. Stains caused by acids are best removed by ammonia; nitric acid stains, however, must be washed repeatedly with a concentrated solution of potassium permanganate, then with water. Remove the brown stain of the permanganate by an aqueous solution of sulphurous acid.

Vegetable acids are less corrosive than mineral acids but are frequently poisonous; the most important acid of this class used in urinary work is acetic acid. An acid substance may be recognized by its power of *neutralizing* an alkali (either entirely or partly), that is, destroying the characteristic properties of the latter.

Acids turn blue litmus paper red and when the urine

has this effect upon such paper it is said to be *acid* and we speak of its *acidity*.

In case a strong mineral acid be accidentally taken internally an alkali must be administered as an antidote such as dilute carbonate of soda, magnesia with milk or water, carbonate of lime, mixture of soda; if an alkali be swallowed by mistake the antidote is an acid solution such as vinegar and water equal parts, lemon juice, or the like. The same substances may be used for external injuries from strong acids or alkalies as the case may be, alkalies for acid burns and acids for alkali burns.

Salts.—A salt is a compound substance containing an acid in combination with a base (the latter term being applied to any compound body capable of neutralizing an acid partly or entirely as oxide of zinc, any of the alkalies, etc., etc.); a salt may also consist of a metal in combination with chlorine, bromine, iodine, etc. It is not necessary that the practitioner trouble himself greatly about these definitions; in this book when we speak of calcium carbon*ate* we mean a salt of calcium containing carbon*ic* acid in combination, when of potassium nit*rite* a salt of potassium containing nit*rous* acid in combination, when of sodium chlor*ide* a salt of sodium containing chlor*ine*.

A solution of ammonia, soda, or potassa is often called solution of ammonium hydrate, sodium hydrate, etc.; in familiar language these may also be termed solution of caustic potash, solution of caustic soda, etc.

Precipitate.—When a reagent is added to urine and a cloudiness or turbidity ensues some substance which heretofore has been dissolved in the urine appears and causes this cloudiness, the urine on addition of the reagent no longer being able to hold the substance dissolved, or else some new and insoluble substance being formed from a

combination of the reagent with some constituent of the urine, a turbidity is seen. Thus if nitric acid be added to urine containing albumin the latter is seen in the form of a cloudiness or turbidity since the acid has rendered the urine incapable of holding the albumin dissolved ; similarly if silver nitrate be added to urine a dense turbidity is at once seen caused by the formation of silver phosphate and silver chloride, both of which salts are insoluble in urine. The technical term for the cloudiness or turbidity thus produced is "precipitate"; albumin may be said to be *precipitated* on adding nitric acid to urine, and silver chloride may be said to be precipitated on adding silver nitrate to the urine.

MICROSCOPE.—The microscopic examination of urine is by no means formidable. Urinary sediments containing crystals are easily recognized and it is only in the case of tube casts, blood, pus, etc., that any great care or experience is necessary. Any achromatic microscope provided with "objectives" and "eye-glasses" giving a power of from 200 to 600 diameters will suffice; the so-called "students' microscopes," if from the hands of a good maker, are all that are required for urinary work.

The object to be examined is placed on a glass "slide" or in a "cell" covered by a thin glass cover to keep out dust, etc., and placed on the "stage"; by means of the "objective" (a lens placed on the lower part of the instrument near the object) and the "eye-glass" (a lens in the upper part near the eye), the magnifying power used may be determined as follows: if the magnifying power of the "objective" is 20 diameters and that of the "eye-glass" 10 diameters, 20×10 or 200 diameters is the total magnifying power of the microscope. Hence a number of different "objectives" and a number of different "eye

pieces" will give a great variety of powers, but for urinary work two objectives are sufficient, namely, a "two-third inch" and a "one-fifth inch"; the "two-third inch" with different eye pieces will give a magnifying power of

FIG. 5.

from 75 to 150 diameters, and the "one-fifth inch" 250 to 700 diameters; in case it be not convenient to obtain these, the one-half inch and one-fourth inch may be used. Physicians, not familiar with the technical terms used by

opticians, in ordering a microscope for urinary work need only specify the kind of objectives mentioned above with eye-pieces necessary to produce a magnifying power of from 75 to 150 and 250 to 700 diameters. The microscope is so constructed that one "objective" can be taken out and another put in with but little loss of time.

The glass "slides" already mentioned are merely rectangular, flat pieces of glass upon which to place the objects to be examined; they should be kept scrupulously clean. The "covers" are of thin glass and are placed over the object when the latter is on the slide; they should not press against the object lest it be flattened or crushed. In most cases in examining sediments shallow glass or gum-dammar "cells" are better than "slides" since being hollowed in form they admit of a stratum of fluid of any degree of thickness and the cover when placed is not so likely to press the objects.

Things Necessary for the Microscopical Examination of Urinary Deposits.—Microscope, two-third inch objective, one-fifth inch objective, several drop pipettes, any number of glass slides, thin shallow cells of glass or gum-dammar and thin glass covers, a flask of distilled water, a piece of old linen, a paste-board cover for the microscope, and a soft camel's hair pencil. The whole on a table having a couple of drawers and placed before a window. Arrange the microscope before a window whose aspect is opposite to the side on which the sun is shining. Obtain a good light at the left hand, then in examination of an urinary deposit proceed as follows: if you have the apparatus described under *pipette* (b.), and have done as described, press the pinch-cock and let a drop of the sediment fall on one of the shallow cells, cover it over with one of the thin glass

covers and remove any urine which may exude at the margin of the cover with blotting paper; next place the cell under the microscope, manipulate the *mirror* so as to obtain proper light and examine with a *low power*, 75 to 150 diameters, first, as this enables you to see more of the deposit, focussing by turning the *movement* or *adjustment* gently until the eye is suited. In case the ordinary drop pipette is used close one end firmly with the forefinger and dip the tapering end down to the very bottom of the test-glass in which you have allowed the urine to settle, raise the forefinger a little so that about an inch of the pipette is filled with the sediment, close the finger over the aperture tightly, take out the pipette from the test-glass, cautiously loosen the finger a little so that about one half the sediment drops out, close it again, wipe off the pipette with a piece of new linen or muslin held in the left hand, then gently raise the fo inger so that a drop of the sediment falls on the shallow glass cell, when examine as before. This latter method of preparing a drop for examination is very troublesome and the physician will do well to obtain the instrument described under *pipette* (b.), as it can be ordered of any dealer in chemical apparatus in the large cities; three or four pieces of india-rubber tubing fitted with glass jets are supplied with each instrument and these when not in use are to be kept in a bottle of dilute hydrochloric acid to prevent their becoming encrusted, being carefully rubbed dry before using.

The microscope can be kept in good order, etc., (i.) if a pasteboard cover be placed over it each time after it has been used, (ii.), if strong acids like nitric and hydrochloric are not added to the objects on the slides or cells (acetic acid will answer in most cases), if (iii.) fumes of chlorine, ammonia and sulphuretted hydrogen do not take up their

abode near it, if (iv.) any dust on the lenses be removed by the camel's-hair pencil, if (v.) spots or finger-stains be gently rubbed off the lenses with a piece of moistened, soft old linen or kid glove, if (vi.) the surfaces be dried with dry, soft old linen, if (vii.) during cold or excessively damp weather the room be heated so that moisture may not form on the lenses, and if (viii.) nobody but the owner dust or wipe it. It is perhaps needless to remark that "objectives" should not be given to teething children wherewith to soothe their aching gums; various rubber appliances of much less cost will answer that purpose with less damage to both child and microscope.

If dust or moisture should have settled on the *mirror* it can be readily wiped off. If any spots should show themselves on the field of view when it is illuminated by the mirror these are probably due to particles adherent to one of the lenses of the eye-piece: and this may be determined by turning the eye-piece round which will cause the spots also to rotate, if their source lies in it. It may very probably be sufficient to wipe the upper surface of the eye-glass (by removing its cap), and the lower surface of the field-glass; but if, after this has been done, the spots should still present themselves, it will be necessary to unscrew the lenses from their sockets and to wipe their inner surface; taking care to screw them firmly into their place again, and not to confuse the lenses of different eye-pieces. Sometimes the eye-glass is obscured by dust of extreme fineness which may be carried off by a smart puff of breath; the vapor which then remains upon the surface being readily dissipated by rapidly moving the glass backward and forward a few times through the air. And it is always desirable to try this plan in the first instance; since, however soft the substance with which the glasses

are wiped, their polish is impaired in the end by the too frequent repetition of the process. The best material for wiping glass is a piece of soft wash-leather, from which the dust it generally contains has been well beaten out. If the object-glasses (objectives) be carefully handled and kept in their boxes when not in use they will not be likely to require cleansing. One of the chief dangers, however, to which they are liable in the hands of an inexperienced microscopist arises from the neglect of precaution in using them with fluids; which when allowed to come in contact with the surface of the outer glass should be wiped off as soon as possible. In screwing and unscrewing them great care should be taken to keep the glasses at a distance from the surface of the hands; since they are liable not only to be soiled by actual contact, but to be dimmed by the vaporous exhalations from skin which they do not touch. This dimness will be best dissipated by moving the glass quickly through the air. It will sometimes be found on holding an object-glass to the light that particles either of ordinary dust, or more often of the black coating of the interior of the microscope have settled upon the surface of the back lens; these are best removed by a clean and dry camels-hair pencil. If any cloudiness or dust should still present itself in an object-glass, after its front and back surfaces have been carefully cleansed it may be unscrewed, cleansed, and screwed together again.—Carpenter.

If the microscope be used at night a flat-wicked lamp fed with one of the best varieties of paraffine oil will prove the most useful light; place the lamp at the left hand so that no light, save that through the microscope, may enter the eye.

MICRO-CHEMICAL REAGENTS. — The chemicals necessary for the identification of sediments described in this book are, acetic acid, ether, carmine solution, iodine water (one grain of iodine, three grains of iodide of potassium, one ounce of distilled water).

Acetic acid should be (i.) concentrated and (ii.) diluted with from three to five parts water; for some work the strong undiluted acid may be needed, but ordinarily the dilute is all that is necessary.

Carmine solutions may be made in various ways: An ammoniacal solution is obtained by dissolving a few grains of pure carmine in a little ammonia and diluting with distilled water. Filter into a flask, and neutralize the solution with a few drops of acetic acid until it has only a very slight ammoniacal odor.

Drop-bottles to hold microscopical reagents are sold, and are very convenient as they obviate the use of pipettes. The stopper is perforated and is elongated below into a fine tube which expands above into a bulbous funnel the mouth of which is coverd with a piece of thin india rubber tied firmly round its lip. If pressure be made on this cover with the point of the finger and the end of the tube be immersed in the liquid in the bottle this will rise into it on the removal of the finger; pressure of the finger on the cover will now expel the liquid.

How to Use Reagents.—When in the course of an investigation it is required to "add acetic acid," it may be quickly accomplished by putting a small drop of the sediment on the cell or slide [by either (a) or (b) under Pipettes], then dip a clean pipette into the bottle of acetic acid and carry a large drop of this reagent to the slide or cell where the drop of sediment is and add it to the latter, place a thin glass cover over it and examine with the

microscope. Note carefully what is seen, remove the slide or cell from the stage, take a clean slide or cell, place on it a fresh drop of the sediment (to which *nothing* must be added), and examine with the microscope, observing what changes have been brought about by the addition of acetic acid by comparing the sediment to which nothing has been added with that to which acetic acid has been added.

If it is desired to note gradual changes on addition of a reagent place a drop of sediment on a clean glass slide and near it a drop of the reagent, put a thin glass cover over the drop of sediment and insert between the slide and cover a thread or pointed extremity of blotting or filter paper, and by capillary attraction a current will be established from the reagent to the sediment.

METRIC SYSTEM EQUIVALENTS.

One gramme equals 15,434 + Troy grains.

One thousand cubic centimetres, or 1 litre, equals about *one quart*, wine measure. The litre is the standard of liquid measure in the French system and is equivalent to 1000 cubic centimeters by volume (just as the United States wine gallon is equivalent to 231 cubic inches); whenever, then, a litre is mentioned the practitioner has only to think of a United States quart. Strictly speaking, the litre equals 1.06552 quarts of a United States liquid gallon, or in other words, a good full quart. In case the quantity of fluid is given in cubic centimetres divide by 1000 to obtain the amount in litres, since 1000 cubic centimetres make 1 litre; thus, given 3500 cubic centimetres of urine, to find how many litres or United States quarts, divide by 1000 and we have 3½ litres exactly, or 3½ United States quarts nearly.

PART I.

PRACTICAL URINALYSIS.

PHYSICAL CHARACTERISTICS.

In making an examination of urine, operations may be carried on in the following order: observe

1. Total quantity in twenty-four hours.
2. Color and appearance.
3. Odor.
4. Reaction.
5. Specific gravity.
6. Abnormal constituents—presence and quantity.
7. Quantity and appearance of deposit—chemical and microscopical characteristics.
8. Presence and quantity of normal constituents.

The physician should at first perform the operations from 1 to 5 inclusive, as directed in pages 25 and 26, carefully noting what he finds in each case; then consult the clinical summary given on page 31.

Quantity in twenty-four hours.—This may be collected by the patient in a clean glass jar, as described in the introduction. If the jar be graduated in fluid ounces or cubic centimetres, the amount passed can be read off very quickly and without the extra trouble of measuring in a separate vessel. The physician should always have some sort of a graduated glass jar for the purpose of measuring

the twenty-four hours urine collected by patients, since the latter are seldom provided with graduated apparatus of any kind; in case the patient be unable to procure a glass jar, any clean vessel capable of holding two quarts will answer the purpose unless the patient be diabetic when a much larger one may be required. It is unquestionably a great aid to the physician to have the entire amount for twenty-four hours under examination, but when this cannot be obtained, examine the urine first passed on rising or that passed three or four hours after the principal meal.

Color and Appearance.—Notice whether the urine when *filtered* be (1) pale, (2) normal or (3) highly colored. If the urine contain no sediment its color may be readily observed without filtering by pouring some into a cylindrical glass jar of not less than four or five inches in diameter, and observing it by transmitted light.

If the urine contain a sediment the latter must be removed by filtration before the color can be accurately determined, since a deposit will often be of such a color as, when in suspension in the urine, to affect the color of the latter; however, if a sediment be a heavy one (as when composed of urates) it may settle completely and the color of the supernatant urine can be observed without the trouble of filtering.

Pale urine varies from colorless to straw-yellow; *normal*, from golden-yellow to amber: *highly-colored* from reddish-yellow to brown. Any unusual color of the urine, as green, black, blue, etc., should be carefully noticed and an explanation sought for in the section, in Part I., headed "Color."

In observing the color of urine, whether it contains a sediment or not must necessarily be noticed also; ascer-

tain if possible whether the urine is (1) *turbid* when first passed, or (2) *clear* when first passed but turbid on cooling.

Odor.—The odor of urine may be either (1) its own—urinous, (2) sweetish, faint whey-like, or that of sour milk, (3) ammoniacal, (4) like rotten eggs—sulphuretted hydrogen, (5) that of odoriferous substances introduced into the organism, as asparagus, etc.

Reaction.—Ascertain whether the urine be (1) acid, (2) alkaline or (3) neutral, as follows: dip or drop two pieces of litmus paper, the one blue and the other red, into the urine, wait until they are entirely saturated and observe whether (1) both are *red*—reaction *acid*; (2) both are *blue*—reaction *alkaline*; (3) one is *red* and the other *blue*—reaction neutral.

If the reaction is found to be alkaline, take a slip of *red* paper, saturate it with the urine until it has turned entirely *blue*, then remove it and allow it to dry; observe whether after it is dry it be (1) yet blue or (2) red again.

Specific Gravity.—To estimate the specific gravity of urine it is well to use a specimen of the mixed urine of twenty-four hours, owing to variations in the specific gravity of urine voided at different times in the day. In ascertaining the specific gravity, the little instrument called the *urinometer* is used; this consists of a glass float weighted below with a bulb of mercury and having a stem graduated from 0 to 60 at intervals of two degrees, usually. The instrument should sink to the zero point when floated in distilled water. At 14 on the scale the letter H is usually printed to the right, and at 26 the letter S; the significance of these letters has been interpreted by some ingenious mind to be "healthy state," i. e., if the urinometer sinks to some division on the scale between 14 and 26 the urine is "healthy." It is

customary to call the zero point 1000 and other points 1014, 1020, etc., prefixing 10 to the numbers on the scale. Before using an urinometer for the first time float it in distilled water of 60° F. temperature and if it does not sink to the zero point or 1000, reject it. In addition to the urinometer procure a glass cylinder or beaker to contain the urine whose specific gravity is to be taken; it is well to have a beaker of sufficient diameter to allow the urinometer to float gracefully without impinging against its sides.

Moreover the beaker or cylinder should have a firm base so as not to be easily upset.

To get the specific gravity of a specimen of urine, fill the cylindrical vessel (Fig. 6,) about two-thirds full, holding the cylinder obliquely while pouring the urine into it thus avoiding as much as possible the formation of foam—if foam forms remove it with blotting paper. Next let the urinometer sink, bulb down, gently into the urine being careful not to have it touch the sides of the cylinder. When it no longer sinks of its own accord, stoop down until the eye is on a level with the urine and read the number on the scale which is even with the *lower convex edge of the fluid*, i. e., *not* the little elevation of liquid which by capillary attraction climbs up the stem of the urinometer a short distance, but the general surface of the urine. Depress the urinometer one degree, allow it to rise, and read again; if the second reading agrees with the first the figure is correct.

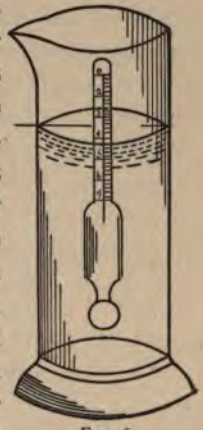


FIG. 6.

Patients living at a distance have a provoking habit of sending a fluid drachm or two of urine for examination as though it were worth a dollar a drop and they could not afford more. When a very small quantity of urine is thus furnished the specific gravity must be ascertained by dilution as follows: take *one* part of the urine and add *three* parts of distilled water to it so as to make enough liquid to fill the cylinder, say two-thirds full, and take the specific gravity as before with the urinometer. After obtaining the specific gravity multiply the last figure of it by 4 and the result is the specific gravity of the urine; thus if the specific gravity of the mixture be 1005, then multiply 5 by 4=20 and 1020 is the specific gravity of the urine itself. In other words, multiply the last figure of the specfic gravity found by the total number of parts of urine and water.

Before taking the specific gravity of urine with an urinometer see whether the fluid has a temperature of 60° F. or not by dipping a chemical thermometer into it; if it has a temperature of about 60°, simply take the specific

Temperature.	No. to be added to the indication.	Temperature.	No. to be added to the indication.	Temperature.	No. to be added to the indication.
60°	0.00	69°	0.80	78°	1.70
61°	0.08	70°	0.90	79°	1.80
62°	0.16	71°	1.00	80°	1.90
63°	0.24	72°	1.10	81°	2.00
64°	0.32	73°	1.20	82°	2.10
65°	0.40	74°	1.30	83°	2.20
66°	0.50	75°	1.40	84°	2.30
67°	0.60	76°	1.50	85°	2.40
68°	0.70	77°	1.60	86°	2.50

gravity, but if has *not* a temperature of 60°, after taking the specific gravity consult the above table of Bird.

Urinometers are constructed for use at a certain temperature, 60° or 62° F., hence when the urine has a temperature other than 60° or 62° the reading will not be absolutely correct. It will be seen from the table that unless the temperature of the urine be 70° or over there will be only fractions of one degree of difference; thus, suppose on dipping the chemical thermometer into a specimen of urine we find its temperature to be 66°. Taking the specific gravity with the urinometer we find it to be 1030; consulting the table we find five-tenths corresponding to a temperature of 66°, hence the true specific gravity is 1030.5. Suppose now another specimen has a temperature of 86° and a specific gravity of 1028; consulting the table we find 2.5 corresponding to a temperature of 86°, hence 1028+2.5=1030.5 is the true specific gravity. If the urine be of the temperature of the surrounding air in the room its specific gravity will be sufficiently correct for clinical purposes without making the corrections indicated by the table, provided, of course, the room be not of an extreme temperature, hot or cold; if for any particular reason, as in estimation of quantity of urea, etc., the accurate specific gravity be desired, the table should be used. If the urine be below the temperature of the room, warm it.

Estimation of Solids.—To estimate approximately the amount of solid matters contained in the urine proceed as follows: 1st, collect the urine of twenty-four hours; 2d, measure it in cubic centimeters by means of a flask graduated in cubic centimetres; 3d, divide the amount of cubic centimetres found by 1000 and number the result (I). Next take the specific gravity of the urine and multiply the two right hand figures by 2 (Trapp's coefficient). Multiply this result by the figure numbered (I)

above and the product will be the amount of solids (in grammes) in the urine of twenty-four hours. If the amount be desired in *grains* instead of grammes multiply the amount found in grammes by 15.4.

EXAMPLE I.

Amount of urine, 3000 cubic centimetres in twenty-four hours.

$$3000 \div 1000 = 3. \quad \text{(I.)}$$

Specific gravity of urine 1008. $08 \times 2 = 16$, (last two figures of specific gravity multiplied by 2). $16 \times 3 = 48$ (this result multiplied by number found according to I.)

This urine then contains 48 grammes of solids in the total amount passed in twenty-four hours; to find the amount in grains multiply 48 by 15.4 = 739 grains.

EXAMPLE II.

Amount of urine, 400 cubic centimetres in twenty-four hours.

$$400 \div 1000 = 0.4. \quad \text{(I.)}$$

Specific gravity of urine, 1002. $02 \times 2 = 4$ (last two figures of specific gravity multiplied by 2). $4 \times 0.4 = 1.6$ (this result multiplied by number according to I.)

This urine then contains 1.6 grammes of solids in the total amount passed in twenty-four hours; to find the amount of solids in grains multiply 1.6 by 15.4 = 24.6 grains.

This method of calculating the amount of solid constituents may give a result any where from $\frac{1}{10}$ to $\frac{1}{4}$ out of the way but it will indicate sufficiently correctly any marked change in the total amounts from day to day.

In calculating the amount of solid constituents some attention must be paid to the daily amount of food; thus

a litre of soup will add nearly fifteen grammes of solid matter to the urine, therefore it is best to ascertain from the patient how much of this substance he has taken in a day, if any.

CLINICAL SUMMARY.

(Physical Characteristics.)

Quantity in Twenty-Four Hours.—Possible normal range, 800 to 2000 cubic centimetres (1½ to 4 pints, nearly).

Usual normal range, 1200 to 1400 cubic centimetres (2½ to 2⅞ pints, nearly).

Large persistent increase (over 2000 cubic centimetres), suspect (i.) diabetes; (ii.) certain forms of Bright's disease.

Temporary increase, after (i.) hysterical paroxysms; (ii.) other convulsive attacks of both sexes.

Decreased quantity, in (i.) height of all acute febrile disorders, (ii.) certain stages of Bright's disease and dropsy, (iii.) cirrhosis of liver.

Color.—Normal range, golden-yellow to amber.

Pale, after copious drinking (urina potus) also in (i.) anæmia and chlorosis, (ii.) diabetes, (iii.) hysteria and convulsions, (iv.) convalescence from acute diseases, (v.) atonic gout.

High, in (i.) fevers, acute diseases, etc.

Abnormally colored, from (a.) disease or (b.) accidental constituents. See Part II.

Odor.—Normal, sui generis, urinous.

Sweetish, whey-like or like sour milk, in diabetes mellitus.

Ammoniacal or putrid, decomposed urine; if so when freshly passed suspect cystic troubles.

Gangrenous, in some forms of Bright's disease.

Aspect.—If clear not necessarily normal, but if normal must be clear.

Turbid, when freshly passed, suspect presence of *pus, mucus, epithelial cells*, etc., suggesting cystic troubles.

Clear when first passed but sedimentary on cooling, *urates* may be present.

Reaction.—Normal range, slightly acid to neutral or alkaline (after meals).

Strongly acid, in febrile disorders.

Alkaline, (from fixed alkali) in (i.) anæmia and chlorosis, (ii.) pulmonary disorders and (iii.) some acute diseases. See Part II.

Alkaline (from volatile alkali), when freshly passed, in cystic troubles.

Specific Gravity.—Normal range, 1015 to 1025.

High, in febrile states—1030 to 1040.

Permanently high in diabetes mellitus—1030 to 1055.

Low, when quantity large, (i.) urina potus, (ii.) polyuria and certain stages of dropsy.

Low, when quantity small, certain stages, Bright's disease.

Solids.—Normal amount 55 to 75 grammes (850 to 1155 grains, nearly).

Decreased (i.) in acute disease (40 to 50 grammes) or (ii.) when quantity of urine abundant *hydruria* (many cases of hydræmia and dropsy), (iii.) most chronic diseases.

N. B.—Increase of solids of the urine at the height of acute diseases usually an unfavorable sign.

Increased, in (i.) diabetes.

ABNORMAL CONSTITUENTS.

Detection of Albumin.—Albuminous urine is often of low specific gravity, 1010 to 1002, is generally turbid and apt to retain any foam which forms on its surface.

Before testing for albumin the urine should be filtered if very turbid and the following tests may then subsequently be made: (*a.*) Take the reaction of the urine—if *alkaline* add a few drops of acetic acid, otherwise not—boil and add an abundant amount of nitric acid; if the urine which originally, or after being filtered, was clear, is now turbid, *albumin* is present. If the urine shows no turbidity, after such treatment, take a fresh amount, filter it and, (*b,*) filling a test-tube one-third full allow twenty or thirty drops of pure, colorless nitric acid to trickle slowly down the side of the inclined tube to the bottom of the urine; if a *white disc* appear above the layer of acid, *albumin* is present, as may be proved by heating—urates clear on heating, albumin does not; if there is no albumin there will be seen merely a layer of acid at the bottom of the tube, above which will rest the urine. In heating hold the tube by the closed end and heat that portion when turbidity is seen. If albumin be not found by tests *a* and *b* take a fresh amount of the urine, filter it, if necessary, add (*c*) two drops of acetic acid to, say, half a test-tube full of urine and then pour in some solution of potassium ferrocyanide. If even a very small amount of albumin is present a turbidity will be seen.

The tests *a*, *b*, and *c*, may readily be made in the physician's office but at the bedside of a patient a simpler one is desirable, and the following has been suggested by Raabe: Into about one cubic centimetre of the suspected

urine contained in a narrow test-tube, drop (*d*) a crystal of trichloracetic acid and, without shaking, let the urine stand until the crystal has dissolved. If albumin is present a distinct turbidity appears at the bottom of the test-tube in sharp contrast to the urine in the upper part; if urates are present a generally diffused but slight turbidity may appear which heat will clear; if the urine is very turbid some of it should be decanted, or, if possible, filtered. It is well to confirm this test subsequently by use of tests *a* and *b*.

If a patient has been taking drugs containing a resin, such as cubebs, copaiva, sandal-wood, turpentine and the like, test *a* on being applied may produce a turbidity in the urine which is not due to albumin. In this case add alcohol, and the turbidity, if due to a resin, will be cleared, but if due to albumin will not be affected.

Some forms of albumin may be encountered in the urine which test *a* will fail to detect; in this case test *b* is of service.

Estimation of the Quantity of Albumin.—The following is a rough but useful *approximate quantity* test: Boil a given quantity of the urine in a test-tube—with a drop or two of acetic acid, if alkaline; set aside for five or six hours. The precipitated albumin sinks and forms a layer of varying thickness. The proportion of albumin is estimated by the depth of this layer as compared with the height of the column of urine and may be expressed in numbers as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$, etc. If too little albumin is present to form a layer, call it "cloudiness" or "opalescence." The urine should first be filtered and a graduated tube used if possible.

Dr. Wm. Roberts estimates albumin *by dilution*, as follows: Take a clear glass jar capable of holding 2000 or

or 3000 cubic centimetres of fluid; into this place five cubic centimetres of the albuminous urine and dilute it with five cubic centimetres of clear water. This dilution may be termed the "first degree"; add to it some nitric acid, a few drops. If cloudiness occurs, again add another five cubic centimetres of water, and again, if necessary, test with nitric acid; this second dilution forms the "second degree." And continue in this manner until the acid occasions no reaction after the liquid has stood for thirty seconds, but occasions a faint opalescence at the forty-fifth second; this is the zero point of the reaction. Now divide the number of the dilutions or degrees required by 5 (the number of cubic centimeters of urine used to start with), which will give "the degrees of albumin" each degree of which he has ascertained by calculation to be an indication of .0034 per cent of albumin in the urine tested. Suppose 1200 cubic centimetres of urine to be passed in the twenty-four hours, five cubic centimetres of which required 1250 dilutions before the zero reaction was attained; then $1250 \div 5 = 250 \times .0034 = .85$ per cent of albumin; 1200 cubic centimetres multiplied by .85 equals 10.2 grammes of albumin in this urine of twenty-four hours.

Detection of Blood-Extractives.—If tincture of galls be added to urine and a precipitate immediately occur the presence of blood-extractives is indicated.

Detection of Sugar.—If the urine contain a *plentiful amount* of sugar a simple and convenient clinical test is the following: Add an equal amount of a freshly-made solution of potassa (specific gravity 1060) to the urine and holding the lower closed end of the test-tube between the thumb and forefinger heat the urine in the upper part of the tube to boiling; if sugar be present the heated

portion will be colored yellow, then brown-red (or even dark purple if a large quantity of sugar is present), while in the non-heated part of the tube the urine does not change its color. Addition of a little nitric acid causes an odor to be given off somewhat resembling that of molasses. A whitish, flocculent precipitate of phosphates should not be mistaken for a reaction of sugar, in applying this test. In case the above test give an unsatisfactory or doubtful result the practitioner should by all means try Fehling's test liquid or some of its modifications; that used by Prof. Haines is a perfectly stable preparation and if the physician be so situated as to be able to procure the ingredients and prepare the solution he had far better confine his attention to it without trying the first test given above. Haines's formula is as follows:

Pure sulphate of copper, - - - -	grains,	30
Pure glycerine, - - - - -	fluid drachms,	2
Pure caustic potash, in sticks, -	drachms,	1½
Pure water, - - - - - - -	fluid ounces,	6

Dissolve the sulphate of copper and glycerine in a portion of the water and the caustic potash in the remainder; mix the two solutions, when a perfectly clear, transparent, dark-blue liquid should result, which may be bottled and set aside for use. After a week or two a slight reddish deposit may appear which, however, does not affect its value as a test; in using, simply decant the clear liquid from the sediment. In preparing the solution if pure caustic potassa in sticks cannot be easily obtained, use instead 3½ fluid ounces of the officinal liquor potassæ, reducing the quantity of pure water to 2½ fluid ounces, the other ingredients remaining as above. To test for sugar take a fluid drachm or two of the test solution and gently boil it when no change should take place; now add

six or eight drops of the suspected urine and again heat to the boiling point. If sugar be present an abundant yellow or yellowish-red precipitate will be thrown down; if sugar is not present no such precipitate appears but the color of the test solution will be rendered somewhat lighter and often of a greenish or even of a greenish-yellow shade by the dilution of the blue test liquid with the yellow urine. A white flocculent deposit of phosphates from the urine used should not be mistaken for a reaction of sugar.

If any one be perplexed by the deposit of phosphates and the change of color produced by dilution of yellow urine with the blue test liquid he is recommended to try the following method of procedure which although rather long and tedious, leaves little room for doubt: Dissolve 34.64 grammes pure crystallized sulphate of copper, free from iron and moisture, in 200 cubic centimetres of distilled water. 173 grammes of Rochelle salt are next dissolved in 480 cubic centimetres of caustic soda solution (specific gravity 1.14) and to it the copper solution previously made is added, and the whole diluted with distilled water to exactly one litre. Heat to boiling, in a good sized test-tube, 10 cubic centimetres (2.7 fluid drachms) of the solution, previously introducing a few small fragments of clay tobacco-pipe to prevent bumping, *i. e.*, spasmodic boiling. When boiling add ½ to 1 cubic centimetre (8 to 16 drops) of the urine which has been previously treated as follows: Albumin, if present, removed by heating the slightly acid or acidified urine to boiling and then filtering from any precipitate. Next (or—if the urine contain no albumin—*first*,) rendered distinctly alkaline by addition of caustic soda solution, filtered from any precipitate of phosphates, etc., and finally added to

the boiling Fehling solution, in amount ½ to 1 cubic centimetre, as specified above.

If sugar be abundant as in a decidedly diabetic urine, a yellowish or brick-red opacity and deposit will be produced. If a doubtful reaction is obtained, test for traces of sugar by adding 7 or 8 cubic centimetres of the urine to the hot liquid, heating again to ebullition and then setting the tube aside for some time. If no turbidity is produced as the mixture cools, the urine is either free from sugar or at any rate contains less than 0.025 per cent. If the quantity of sugar present is small—that is under 0.5 per cent—the yellow or red precipitate does not take place immediately, but occurs as the liquid cools, the appearance being somewhat peculiar. The liquid first loses its transparency and passes from a clear bluish-green to an opaque, light-greenish color. This green, milky appearance is quite characteristic of diabetic sugar.

The test given above is recommended by Allen, of Sheffield; several circumstances must be noted in applying it: I. Fehling's solution, made as described, undergoes certain obscure changes on exposure to air and light, hence it is better to prepare this solution in two parts, namely (*a*) 500 cubic centimetres of the Rochelle salt solution and (*b*) 500 cubic centimetres of the sulphate of copper solution. This may be done by adding water to each solution separately until each amounts to 500 cubic centimetres, rather than adding enough water after the two have been mixed, to make 1000 cubic centimetres or 1 litre, as directed previously. Instead, therefore, of mixing the copper sulphate solution and the Rochelle salt solution keep them in separate bottles and mix in equal volumes only when used. Thus, if according to direction 10 cubic centimetres of Fehling's solution are required,

add 5 cubic centimetres of the copper solution to a like amount of the Rochelle salt solution. II. Much of the Rochelle salt of commerce is impure; the safest method of preparing it is as follows: Dissolve commercial cream of tartar in hot water, adding carbonate of sodium till the liquid remains slightly alkaline after boiling, filtering from the precipitated calcium carbonate and crystallizing the Rochelle salt from the clear liquid. III. Too much importance must not be laid upon detecting traces of sugar since normal urine often contains small amounts of this substance.

Estimation of Sugar.—The simplest method of determining the quantity of sugar in urine is the "differential density fermentation test" which is performed as follows:

a. Pour four fluid ounces of urine into a twelve ounce bottle;

b. Next add a lump of German (condensed) yeast the size of a chestnut;

c. Find a cork that does not fit the bottle well and loosely cork the bottle with it;

d. Set the bottle in a warm place; some authors suggest the "mantle-piece," evidently forgetting that the rage for bric-a-brac has somewhat subsided;

e. Now find another twelve ounce bottle and pour into it four fluid ounces of the same urine;

f. Find a cork that fits it *very tightly*, cork and set side by side with loosely corked bottle "No. 1," being careful *not to add any yeast* to tightly corked bottle, No. 2;

g. Next allow twenty-two hours to elapse and then remove both bottles to a cool place and let them rest two hours more;

h. Procure two beakers or cylindrical vessels and at the expiration of the two hours pour the contents of bottle No. 1 into one beaker and those of No. 2 into the other;

i. Take the specific gravity of each with the urinometer; the specific gravity of the urine in bottle No. 1 will be less than that of the urine of bottle No. 2, owing to fermentation in No. 1 caused by yeast, having changed the sugar into alcohol and carbonic acid; the latter substance, being a gas, escapes;

j. Subtract the specific gravity of the urine of bottle No. 1 from the specific gravity of the urine of bottle No. 2, and the difference is grains of sugar to the fluid ounce of urine.

For instance, suppose the specific gravity of the urine in bottle No. 1 is 1020, and that of bottle No. 2, 1040; 1040 less 1020 equals 20. This signifies that the urine contains 20 grains of sugar to the fluid ounce of urine; the urine for twenty-four hours, of which the urine examined has been a sample, having been measured is, say, 100 ounces; then 100×20 will give the total amount of sugar in grains for the twenty-four hours, viz., 2000 grains.

Detection of Albumin and Sugar when together. — When it is desired to test urine for sugar, which is suspected, or has been found to contain albumin, proceed as follows: Take the reaction, and if alkaline, add a drop or two of acetic acid — otherwise not — boil thoroughly and the albumin will be precipitated. Let the urine remain at rest until the albumin has settled to the bottom of the tube, then pour off carefully the supernatant urine and test it for sugar by any of the methods previously mentioned.

Detection of Bile Coloring-Matter.— Fill a test-tube half or two-thirds full of urine and allow 20 or 30 drops of red nitric acid (commercial nitric acid which has been exposed to the sun's rays) to trickle slowly down the side of tube held inclined. At the juncture of the urine with the acid a play of green and blue colors will be seen, especially if the tube be held before some white object, as the wall.

CLINICAL SUMMARY.

(Abnormal Constituents.)

Albumin.—A notable amount of albumin occurs in the urine of (i.) many acute diseases, (ii.) Bright's disease, (iii.) pregnancy and the puerperal state, (iv.) after the administration of, and in poisoning by, various drugs.

a In cases of pregnancy where albumin is found in the urine examine the deposit with the microscope for *casts* and other evidences of renal disease — mere presence of albumin without casts, etc., is not necessarily alarming.

b. A pale, dilute urine abundantly albuminous is more indicative of Bright's disease than a dense high-colored urine with less albumin; the latter is more apt to be indicative of pyrexia or some impediment to the circulation. In cases of suspected Bright's disease observe (i.) quantity of urine in twenty-four hours, (ii.) albumin, (iii.) tube casts, epithelia, etc., in the deposit, using the microscope.

c. In diphtheria, albumin may be found in the urine early in the course of the disease.

d. If the urine contains pus, blood, spermatic fluid or leucorrhœal discharge, then albumin corresponding to the same, may be found.

Sugar.—Sugar *persistently* present in the abundant urine

of high specific gravity, in connection with the well-known symptoms of hunger, thirst, emaciation, etc., indicates diabetes mellitus.

Albumin and Sugar together.—Found in (i.) glycosuria, (ii.) diabetes mellitus, (iii.) chyluria.

Bile.—The presence of bile *coloring-matter* in the urine is of slight clinical importance; it may be found in the urine of (i.) icterus, (ii.) phosphorus poisoning, and (iii.) after severe burns.

Extractive matters—Presence of blood-extractives in the urine shown by *immediate* precipitate with tincture of nut-galls may be found (i.) in Bright's disease—before appearance of albumin and after its disappearance, (ii.) irritation from renal calculus before albumin, blood or pus, etc., have appeared.

DEPOSITS.

Beale divides deposits into three classes:

I. Light, flocculent, transparent, voluminous deposits—mucus and epithelium, spermatozoa, vibriones, fungi, casts.

II. Dense, opaque, bulky—urates, pus, phosphates.

III. Granular or crystalline, small bulk, sinking to bottom or deposited on sides of the urine glass—uric acid, calcium oxalate, triple phosphate, cystin, lime carbonate, blood corpuscles.

N. B.—A very thick, glairy, gelatinous deposit is pus altered by the action of ammonium carbonate in the decomposing urine.

Method of Recognizing the Constituents of a Deposit.—Ascertain as nearly as possible to what class (mentioned

above) the deposit belongs, next apply chemical tests and verify with the microscope if necessary.

Non-Organized Deposits.

Recognition of an Urate Deposit.—Let the urine settle, pour off the supernatant liquid, pour some of the sedimentary urine at the bottom into a test-tube, heat (*not to boiling*, lest any albumen present be precipitated,) and if the urine *clears* the presence of a urate deposit is indicated. Stand the test-tube aside and if on cooling the urine becomes turbid again the correctness of the conclusion is verified. The practitioner sometimes mistakes urates for albumin; urates are a *deposit* in the urine clearing on the application of gentle heat—albumin is never a deposit in urine but coagulated by heating to nearly the boiling point; in other words, gentle heat causes the urates to *disappear*, boiling heat, albumin to appear. Suppose then the urine contains a sediment of urates and albumin—gentle heat will cause the urate deposit to disappear and the urine to become comparatively clear, but further heating will now cause a turbidity due to the presence of albumin, and on boiling the urine will become persistently cloudy. The microscope is not indispensable for the recognition of urate deposits as distinguished from others, but it is worth while to know whether the urates themselves are amorphous (non-crystalline) or crystalline. If a deposit, which by chemical means has been ascertained to contain urates, be examined with the microscope the appearance, if the urates be amorphous (non-crystalline), is that of irregular particles or granular powder; in rare cases the so-called "hedge-hog" crystals of sodium urate may be seen (Fig. 7). If seen in *stale* urine prismatic

crystals arranged in star-like masses may be noticed, which are of no clinical import.

Recognition of an Uric acid Deposit.—Urine depositing uric acid has usually a rich yellow or orange color and invariably an acid reaction. Uric acid crystals are often visible to the naked eye, forming a film on the surface of

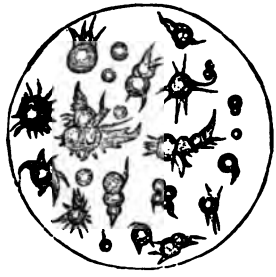


FIG. 7.

the urine or lying scattered like brown specks on the sides of the glass, eventually subsiding into a dense red deposit resembling cayenne pepper. Urates are often associated with uric acid.

Chemical Detection.—Heat (not to boiling) a little of the deposit in a test-tube, and if it clears either partly or wholly *urates* are present; to any residue add liquor potassæ and again heat gently, if any or all dissolves *uric acid* is present. In applying this test it is desirable to separate the deposit from the urine either by careful decantation or by filtration, as liquor potassæ and heat will throw down earthy phosphates normally present in urine if any of the latter be present in the tube; the microscope affords a more rapid method of identifying an uric acid deposit.

Microscopical Appearances.—The distinctive feature of

uric acid crystals is their *color* which may be red, yellow or brown, unless by some chance they have been broken or crushed when the fragments may have a whitish appearance. The higher the color of the urine the darker

FIG. 8.

the crystals, and *vice versa*; if the urine be of any abnormal color, as blue or black, the uric acid crystals will be the same. Use a low power, say 100 to 200 diameters, and four-sided rhombs or "blocks" will be seen, or sometimes hexagonal plates; occasionally when seen on certain surfaces they may take the form of large stars or daggers. Fig. 8 shows the common forms which uric acid crystals may assume and Fig. 9 the rarer.

Recognition of an Oxalate of Lime Deposit.—Urine depositing oxalate of lime may be (i.) high colored, or (ii.) of a pale greenish color, according to the conditions present. The deposit itself may be very scanty, colorless, and very like a mucus "cloud." The form of the crystals

is so characteristic that no chemical test is necessary, the use of the microscope sufficing. Oxalate of lime does not dissolve in strong acetic acid and in this way may be told from the phosphates. It is insoluble in liquor potassæ and thus differs from uric acid.

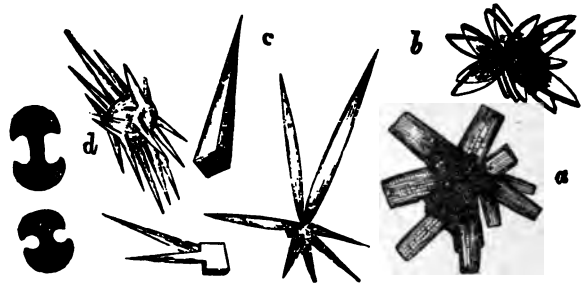


FIG. 9.

Microscopic Appearances.—The crystals are very small requiring a power of from 400 to 600 diameters to show them well, although any one familiar with them can detect them with a lower power. Their appearance is that of the rear of a letter envelope (Fig. 10) or sometimes that of a dumb-bell. They are, in the former case, octahedral in form, and very transparent; hence the focussing is sometimes difficult. They may be more readily detected by moving the slide so that the edge of the cover comes in to the centre of the field; then focus clear and move the deposit. To produce lime oxalate crystals artificially add to the urine a little lump of oxalic acid and after a few hours examine with the microscope.

Recognition of a Phosphatic Deposit.—Urine containing a deposit of phosphates is usually of an alkaline or at most feebly acid reaction; its appearance is often "milky," and on standing, the whitish deposit settles to

the bottom of the urine glass and does not increase as the urine cools. Urate deposits are sometimes of so light a color as to be mistaken by the eye for phosphatic sediments.

FIG. 10.

A.—Octahedral crystals of oxalate of lime. B.—The same when dry. C.—Dodecahedral crystals of lime. D.—Dumb-bells—oxalurate of lime. E.—Oval forms of oxalurate of lime.—King.

Chemical Detection.—Heat the deposit from which most of the urine has been decanted and it does not dissolve; add a drop of nitric acid and it is dissolved.

Microscopical Appearances.—Obtain a drop from the bottom of the urine glass in which the deposit has settled and place upon a slide; if the urine be pale and faintly acid possibly the "stellar" phosphate (crystalline calcium phosphate) may be present (Fig. 11). This deposit, however, is not a common one.

Usually the amorphous or non-crystalline calcium phosphate may be seen in such whitish deposits occurring in the form of granules, roundish or oval, with

FIG. 11.

Urinary deposits consisting of crystals of phosphate of lime, octahedra of oxalate of lime with a little mucus (215 diameters).—Beale.

lines, isolated, or else three or four united in a star-like form or in beads, etc.; more often this phosphate shows very pale, small, transparent globules, hard to see, and always united by irregular punctated patches.

The latter form is the more common appearance; a drop of acetic acid will dissolve both forms of the amorphous calcium phosphate (Fig. 12 D).

Ammonio-magnesium phosphate is very easily recognized; it occurs as very large, transparent crystals with sharply-defined edges, generally isolated and having the typical form of a triangular prism with beveled edges, found only in alkaline urine and soluble in acetic acid (Fig 12 A).

It must be remembered that a deposit of phosphates does not necessarily indicate excess of the same but merely diminished acidity of the urine.

FIG. 12.

A—Prismatic crystals of triple phosphate. B—Penniform crystals of triple phosphate. C—Stellar and foliaceous crystals of triple phosphate. D—Mixed phosphates; amorphous phosphate of lime.

A few drops of solution of sesquicarbonate of ammonia (one drachm of the salt to one fluid ounce of distilled water), added to urine passed after the digestion of a meal, will precipitate the neutral tr ple phosphate.—(King).

Detection of Fat in the Urine.—*Chylous* urine has a milky, turbid and opaque appearance due to presence of fatty matter. Upon standing for some time a tremulous coagulum occurs succeeded by flakes, the fatty matter floating like cream on the surface. [Add ether to the urine, mix gently, the fatty matter is dissolved and the urine assumes its natural color and transparency. If the ether be drawn off with a pipette and evaporated it will yield a yellowish fat, solid or fluid]. Oil globules are rarely to be seen with the microscope since the fat is

present in molecular form; with high powers, 450 diameters and upward, fatty particles may be seen.

Fatty globules present in renal casts will be hereafter noticed. Fat or oil globules, themselves, are easily identified by the microscope if not dissolved by other constituents of the urine; they present the form of smooth, roundish, flattened discs, or if compressed are polyhedral in form; they strongly refract light which gives them a sharp, dark outline with transmitted light and with reflected light a whitish centre and a shining silvery outline.

To practice identification of fat in the urine agitate strongly some fresh urine with a little milk and then examine a drop with the microscope.

CLINICAL SUMMARY.

(Non-Organized Deposits.)

Deposits of Urates and Uric Acid.—These are found in

I. Normal urine in winter; if occasional, of no clinical significance.
II. Extensive cutaneous diseases as eczema, psoriasis.
III. Forms of dyspepsia associated with irregular secretion of gastric juice.

} *Absolute* increase in acidity of the urine.

IV. Normal urine in summer; if occasional, of no clinical significance.
V. At the height of febrile disorders, especially rheumatism, and in diarrhœa.
VI. Alternating with sugar in the urine.

} *Relative* increase in acidity of the urine.

In these diseases uric acid is not necessarily in *excess* but changes in the acidity of the urine cause it and the urates to be deposited. *Excess* of uric acid and urates is found in the urine in the following diseases:

I. Diseases of the liver as acute yellow atrophy, cirrhosis and cancer; also in scurvy. } Decrease of other constituents.

II. Functional derangements of the liver, especially when too much animal food is ingested.

III. Antecedent conditions to the development of phthisis, cancer or sometimes diabetes; preceding the outbreak of such constitutional conditions as scrofula, syphilis, and of gout in its early attacks.

} Increase of other constituents.

Although uric acid and the urates be in excess in the urine they may not be found as a deposit.

If a deposit of uric acid occurs before the urine cools, or immediately after, the formation of gravel or stone is to be dreaded; if the deposit occurs three or four hours after the urine is passed, gravel and stone are not so much to be dreaded; if the deposit occurs twelve to twenty hours after the urine is voided when acid fermentation has set in, it is perfectly normal.

Deposits of Oxalate of Lime.—These may be due to

I. Physiological causes: *a.* Derived directly from the food by the ingestion of substances containing oxalate of lime, as rhubarb, etc. *b.* Derived indirectly from the food by incomplete oxidation of the sugars, starches, and fats. Regulation of diet, change of air, etc., improve the condition.

II. Pathological causes: *a.* Many disorders of the liver, heart and lungs—high-colored urine. *b.* Spermatorrhœa. *c.* Cases of dyspepsia to which the term "oxaluria" is given owing to the persistency of the oxalate deposit—light colored urine.

A constant, large deposit of oxalate of lime renders the formation of oxalate of lime (mulberry) calculus possible.

Deposits of Phosphates.—These are due to an alkaline or neutral reaction of the urine and may be found:

I. Normally after a meal or after partaking of fruit, carbonates, citrates, or acetates.

II. Abnormally in various conditions: *a.* If the deposit be seen daily and be *amorphous*, i. e., contain no crystals, nothing of great moment is indicated except *nervous exhaustion*, as from severe study or loss of sleep. *b.* If the deposit be *crystalline* and no diet rich in lime at the same time be taken, diseases of the *spinal-cord* and *chronic vesical* affections are indicated; especially is this the case if the crystals be those of *ammonio-magnesium phosphate* —triple phosphate. If triple phosphate be persistently deposited in the comparatively fresh urine there is reason to fear formation of calculus. Crystals of triple phosphate occurring in stale urine when not found in fresh are of no clinical significance.

Fat in the Urine.—Found in (i.) chyluria—urine containing chyle, (ii.) fatty degeneration of some part of the urinary apparatus, (iii.) constitutional affections associated with marked cachexia as phthisis, pyæmia, etc.

Organized Deposits

Chemical Detection of Blood in the Urine—Fill a bottle two-thirds full of spirit of turpentine, cork it loosely and expose it to the light for several weeks; kept in this way it becomes well ozonized. When the test for blood is to be made take equal parts of this ozonized spirit and of tincture of guaiac, say two cubic centimetres, (about half a drachm) of each, mix and shake thoroughly in a test-tube, when an emulsion is formed. Next, let about an equal quantity of the urine to be tested trickle down the side of the test-tube, held inclined, and let it stand a few moments. If blood be present in the urine a bluish layer will appear at the juncture of the urine and the emulsion,

that is, about in the middle of the whole—(Almen's test). If blood is not present a layer of a dirty yellow color is seen. If the tincture of guaiac be diluted with three or four times its bulk of alcohol this test becomes a very delicate one, detecting even small traces of blood.

Use urine freshly passed for both chemical and microscopical examination when blood is to be looked for.

Microscopical Appearances of Blood.— If the urine is acid and of average specific gravity, say 1020 to 1025, the blood corpuscles will be visible and shapely for several days, but when the urine is ammoniacal especially if it be of low specific gravity, they speedily disappear, in which case the blood coloring matter must be tested for chemically.

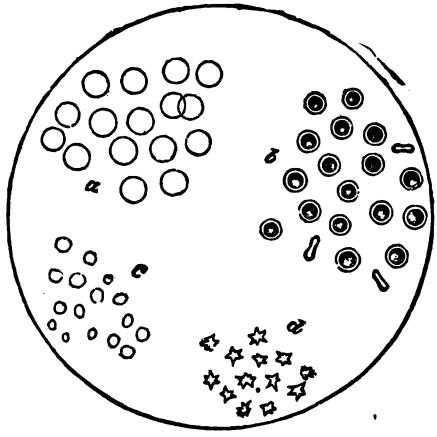


FIG. 13.—BLOOD-CORPUSCLES IN URINE.

a, slightly distended by imbibition; *b*, showing their bi-concave contour; *c*, shrivelled; *d*, serrated.—Roberts.

To understand the appearance of blood in the urine first study that of blood drawn from a blood-vessel, i. e.,

"normal" blood; the microscopical appearance of blood itself is that of globules or corpuscles without nuclei, smooth, flat, non-granular, yellow or reddish-brown and either detached or adhering in rouleaux. The discs being bi-concave a change in focussing will give a dark circumference and a light centre or the reverse; if the fluid containing them be set in motion the bi-concave form will be at once observed. Having learned the appearance of the blood drawn from a blood-vessel next observe that occurring in urine (Fig. 13).

In acid urine, as has been observed before, blood-corpuscles retain their characteristic form for a long time; one point must be noticed and that is that blood-corpuscles in the urine are *separate* and sharply defined and do not run into rouleaux or rows like those of blood drawn from a blood-vessel, except in profuse hæmorrhages from the bladder.

They exhibit, however, small discs showing a central shadow corresponding to the depression, and if standing on their edges they appear bi-concave. They appear reddish with a slight greenish tinge, i. e., paler than the normal.

So much then for the appearance of the blood corpuscles in acid urine of a specific gravity not far from 1028, that of blood serum itself. In case blood be sought for in such urine the practitioner can easily compare the microscopical appearances with those of a drop of blood drawn from his hand by the prick of a needle. If the blood remains in such acid urine for several days its corpuscles may become somewhat notched or indented, thus differing from normal blood corpuscles.

The form of the corpuscles undergoes many changes coincident with those of the urine, and when they are in

watery urine (specific gravity 1010 or less) the description given above will not apply.

In such urine of low specific gravity, the corpuscles imbibe enough water by endosmosis as to swell visibly, to become bi-convex instead of bi-concave, and then even spherical, losing their color from the exosmosis of coloring matter to such an extent that the busy practitioner will lose considerable time in trying to identify them unless he have a very superior or powerful lens.

Urine of low specific gravity containing blood is apt to become alkaline and decompose very soon, and then the blood-corpuscles are no longer recognizable. In order to identify blood-corpuscles with ease, the urine should be acid in reaction, of a specific gravity of between 1020 and 1028, and fresh.

To examine the urine microscopically for blood let it stand for a time until any turbidity may have at least partially settled, then introduce a pipette well into the lower part of the glass and obtain a drop of urine which convey to a glass slide and drop there, place the same under the microscope, focus carefully to suit the eye. If a low power is used the red corpuscles may be confounded with spores of certain fungi; high power will show a nucleus in such spores but none in red blood-corpuscles.

If any uncertainty exist in the mind let the urine stand a few days when the spores aforesaid, if any, will germinate or bud, a habit to which red blood-corpuscles are not addicted.

It is sometimes difficult to distinguish red blood-corpuscles from the nuclei of renal epithelium except by their feeble refractive power and less coloration from magenta solution.

In general, especially if the urine be of acid reaction,

average specific gravity, and recently passed, the following description will lead the hurried physician to recognize the red blood-corpuscles under the microscope:

"Circular discs or globules; non-nucleated; $\frac{1}{3500}$ inch in diameter; separate; edges smooth or dentated; transparent or of a faintly yellowish color; sometimes presenting a central depression, and if seen in profile, with a high power, bi-concave. If a drop of acetic acid be added they swell or shrink and present a 'raspberry' aspect."

If with Almen's test the blue coloration has been obtained and with the microscope blood-corpuscles are identified, hæmorrhage from some part of the urinary apparatus is indicated. In applying Almen's test be sure that the lower strata of urine are examined. In urine of high specific gravity the blood-corpuscles frequently contract, shrivel, and become distorted, indented or "crenated" from exosmosis, so that their microscopical identification is not easy.

Detection of Pus in the Urine.—To detect pus in the urine by chemical means is not always easy, being in some cases impossible. Urine containing pus is milky and turbid when voided, sometimes acid but generally alkaline, is light colored, even whitish, and has the peculiarity of *clearing* on standing; for instance, if a bottle of turbid urine of light color is brought you and after letting it stand a few hours it is noticeably clear, examine the dense, opaque, yellowish-white sediment at the bottom of the bottle for pus.

To do this chemically, first heat a little of the mixed urine and deposit, and if it *does not clear*, carefully drain off all the urine possible without losing any of the deposit; which is conveniently done by holding a glass rod to the lip of the bottle and pouring the urine slowly

so that it will trickle down the rod. Then to the deposit left in the bottle add a small piece of solid potassium hydrate and stir some minutes with a glass rod. If the sediment consist of pus it will lose its white color, becoming greenish and glassy, at first thready, finally more compact, viscous, and stringy, the latter quality being readily noticed if one attempt to pour it from one vessel to another. Mucus treated in the same manner becomes a thin liquid with flakes. If the amount of pus is small the sediment will disappear and a thready, gluey liquid result. It is advisable to obtain the sediment as free from urine as possible, hence, after carefully decanting the urine which has stood for some time, pour the residue into a tall cylindrical vessel and in turn allow this to settle removing supernatant urine gently with a large pipette; in this way a maximum amount of sediment and a minimum amount of urine is obtained without filtering.

The above test is of value only when the urine is acid, or neutral in reaction and fresh; in strongly alkaline urine, pus, if occurring, is changed by the action of the ammonium carbonate formed, into the same gluey, tenacious mass described above. When, therefore, a glairy, ropy deposit is found in urine of alkaline reaction, filter, and examine the filtered urine for albumin, being careful to notice the slightest turbidity. If albumin be found even in very small amount we may infer the presence of pus which, as is well known, contains albumin.

Microscopical Appearances.—If the urine be acid or neutral examine the sediment with a power of from 300 to 400 diameters, and a number of spherical, cellular bodies about one-third larger than red blood-corpuscles may be found (Fig. 14). They may be compared with laudable pus from any suppurating wound or abscess.

If the urine is of high specific gravity the pus-corpuscles will look smaller and more crumpled than when the urine is watery and of a low specific gravity in which they appear expanded and clear. A drop of acetic acid placed under the cover glass will cause the nuclei to appear —the red blood-corpuscles have no nuclei—and cause the granulations to disappear giving rise to residues of various forms and groupings; on further treatment with ammonia the nuclei will disappear and the pus assume a viscous consistency which mucus never, under similar circumstances, acquires. Pus-corpuscles (Fig. 14) can

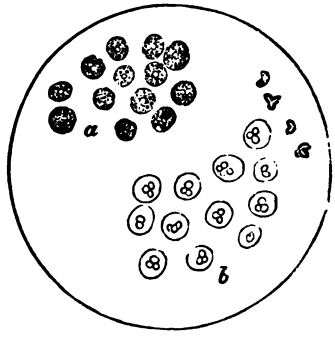


FIG. 14.—PUS CORPUSCLES.
a, without reagents; *b*, after the addition of acetic acid.—Roberts.

not be distinguished, microscopically, from mucus-corpuscles as regards form, etc. When the urine is alkaline the form of the pus-corpuscle is so changed as to be unrecognizable although occasionally leucocytes may be found in the upper part of the deposit together with crystals of triple phosphate, the organisms known as vibriones and filaments of fungi on their way to development. See Part II.

The finding of albumin in the filtered urine, must then be resorted to by chemical means in order to verify, if possible, our idea, that the grayish, viscid, tenacious mass contains pus.

Recognition of Mucus in a Deposit.—Mucus is often present in considerable amount in the urine without causing any turbidity. Urine containing an abundant amount of mucus filters very slowly, and if, after filtration, the filtering paper be dried, it will be found covered with a glistening "varnish" of mucus adhering to its sides.

1. *Chemical Tests.*—To ascertain whether the urine is charged with mucus when apparently clear, add to the freshly voided urine some acetic acid; if a considerable turbidity appear, which is cleared upon addition of hydrochloric acid, mucus in considerable amount is present.

2. When a plainly visible sediment is present in the urine causing one from its appearance to suspect mucus, test the supernatant fluid for albumin, and to a little of the sediment add a few drops of liquor potassæ; if no albumin be found and the addition of the potassa to the sediment render it a thin, flaky liquid, it is mucus and not pus. The urine should be that freshly voided.

Microscopical Appearances.—Examine the desposit collected in the usual manner with a high power, 450 to 500 diameters. Mucus thus examined shows (i.) epithelial cells, (ii.) mucus-corpuscles (iii.) various substances, as urates, uric acid, phosphates, fatty droplets, etc., etc.

It is desirable to identify the *mucus-corpuscles* in examining a deposit for mucus alone; these are identical with pus-corpuscles. If a drop of acetic acid be added to the drop of sediment under examination the nucleus of the mucus-corpuscles will be plainly seen, and pale, delicate,

finely fibrillated, or punctated, bands or threads sometimes tortuous, and frequently anastomosed appear (Fig. 15). This fibrillated substance is *mucin* precipitated from the mucus by the acid. It is difficult to distinguish mucus from pus microscopically, but if mucus-corpuscles be found, test the urine for albumin and treat the deposit with liquor potassæ as before described.

FIG 15.

Recognition of Epithelium in a Deposit.—The microscope must be used for this purpose. Epithelial cells found in the urine are of various forms best shown by Figs. 16 and 17. It is not always easy to tell just where epithelial cells have come from, but the following table may serve as an "approximate guide":

1. Round or oval epithelial cells, a little swollen.	Very large, with a single nucleus generally.	Urethra. Bladder (trigone).
	With two nuclei or one nucleus, and nuclei form granulations.	Pelvis of kidney. Ureters — superficial layer.
	Much smaller.	Kidney — rarely in an isolated state. Bladder — near the neck.

2. Epithelial cells lamellar, very thin, polygonal.	A large nucleus, and often two nuclei and nucleiform granules.	Pelvis of the kidney and ureters—superficial layer.
	Very large lamellæ, but with very small nucleus.	Vagina and external genital parts. Urethra, near meatus.
3. Cylindrical, columnar, spindle-shaped, epithelial cells, with tail longer or shorter and more or less bent.		Bladder. Ureters. Pelvis of the kidney.

FIG. 16.

A.—Glandular epithelium from the kidneys. B—Tesselated-epithelium from the pelvis of the kidneys. C.—Epithelium with large and distinct nuclei, from the ureters. D.—Columnar epithelium, from the fundus of the bladder. E.—Large flattened cells, with a very distinct nucleus and nucleolus, from the trigone of the bladder. F.—Epithelium of the bladder.—(King.)

These cells appear large in comparison with blood or pus-corpuscles when the same power is used to

both. The central structure enclosed within the cell-substance is called the *nucleus*.

FIG. 17.

a, round epithelium from bladder; *b*, columnar epithelium from ureter and urethra; *c* 1, columnar and squamous epithelium from deeper layers of epithelium of bladder; *c* 2, squamous epithelium from superficial layers of epithelium of vagina.—Tyson.

Detection of Casts.—Casts must be identified by the microscope. In order to collect them for examination proceed as follows:

(*a.*) If the urine contains *no deposit*

1. Collect the urine for twenty-four hours.

2. Let it stand in a tall cylindrical glass from twelve to twenty-four hours according to the amount of albumin present, the more the longer.

3. Pour all the urine away except the four or five ounces at the bottom.

4. Let this four or five ounces settle again for two or three hours.

5. Take a drop of urine from the bottom with a pipette (or pour the urine into another vessel and examine one of the last drops) put it on a slide furnished with a *shallow* gum-dammar or cement *cell* and examine with a power of from 100 to 250 diameters (low power in order to include a considerable quantity of urine).

6. Having found tube-casts, study them with a higher power namely, 400 to 800 diameters.

7. If casts be not found on one slide try several, and do not decide upon the case until several examinations have been made at intervals of several days.

(*b.*) When the urine contains a deposit:

If the urine contain an abundance of casts they are much more readily found:

1. Let the urine settle a few hours.

2. Pour off the supernatant urine from the deposit which has settled and examine one of the last drops on a slide with a shallow cell, as before in *a.*

Three or four varieties of casts may be seen:

I. *Epithelial,* (Fig. 18 [5]) consisting of a mass of epithelial cells from tubules of kidney; they are generally wide, seldom narrow.

II. *Granular,* (Fig. 18 [2]) epithelial casts which have undergone molecular change are called "granular" owing to their dark, nearly black, coarsely granular aspect. Granular casts may be studded with minute oil globules, (Fig. 18) in which case they are called "fatty or oil casts." Granular casts may have blood-corpuscles on them, in which case they are called "blood casts"; in such a case they appear either as (i.) perfect cylinders composed of delicate circles placed in apposition or (ii.) more often *fibrinous* cylinders irregularly studded with blood-corpuscles, some perfect, others shrunken and contorted or

(iii.) blood-corpuscles, crushed or compressed into a cylindrical mould. In case the material of the granular casts be derived from broken-down blood-corpuscles, the casts will appear yellowish or yellowish-red. Granular casts may be large or small, full of granular matter or only partially filled.

FIG. 18.

1—Massive fibrin cylinder 2—Granular cast. 3—Hyaline casts. 4—Waxy casts. 5—Epithelial casts. 6—Uric acid casts.—(Hofmann-Ultzmann.)

III. *Hyaline, Structureless or Waxy,* (Fig. 18 [3] and [4]) These are clear cylinders with well-defined margins delineated by a distinct line. They are sometimes rectilinear but more often curvilinear, having their extremities cut like glass; their surface is generally polished. Hyaline

casts are formed of homogeneous, transparent material, and contain cracks and roughnesses due to blood globules and epithelial cells with here and there one or two glistening oil drops; their outlines are often so indistinct

FIG. 19.

that before they can be detected they must be artificially tinted with iodine or magenta, or the light from the mirror illuminating the field of view must be modified by shading with the hand or by manipulating the mirror itself, the field of view being just outside the exact focus.

Hyaline means "transparent like glass," hence the name of these casts; when they are of more solid aspect they are termed "waxy" casts, from the resemblance to "molten" wax. Amyloid casts are hyaline casts which have undergone metamorphosis.

In advanced stages of Bright's disease the hyaline casts

may be completely enclosed in a cortex of epithelial cells from renal tubules.

IV. *Mucus Casts,* (Fig. 20). Not to be confounded with hyaline casts are those called mucus, which may frequently be found in normal urine; they have badly defined margins, are often twisted or varicose, but they are pale and smooth. Mucus casts are characterized by their great length, which is often enormous, in the course of which they divide and subdivide, diminishing in diameter

FIG. 20.

as the division proceeds. They are often present with pus. According to Beale, also in urine of high specific gravity (1030 and upward) containing excess of urea and urates. As they are of no diagnostic value they must not be mistaken for hyaline casts.

Acetic acid renders them fibrillary and punctated, but attacks hyaline casts very slightly.

Besides the four varieties of renal casts mentioned, there are sometimes present in urine casts of the *seminal*

tubules which may be distinguished, microscopically, from the preceding by the presence in them of spermatozoids.

Fibres of wood, cotton, flax, wool, silk are often mistaken for casts, likewise hair and other foreign bodies; if some of the deposit be placed on a slide and a thin glass cover put over it, pressure on the cover with a needle will crush a renal cast but merely flatten any foreign body likely to be present. Hence it is desirable not to look for tube casts on an ordinary slide with a cover lest they be crushed; it is better to use, as previously specified, a slide with a cell in it.

To decide whether an object seen with the microscope is a tube cast or not proceed as follows:

1. Rule out foreign bodies by the method of procedure given above.

2. Notice whether imbedded in or firmly adherent to the object are epithelial cells from uriniferous tubules, red blood-corpuscles or leucocytes. If no epithelial cells *at all*, examine several slides before concluding whether the objects are casts or not, since in the last stages of Bright's disease the uriniferous tubules have, in some cases, been stripped of their lining epithelium, hence no cells will be seen in or on the casts.

3. Observe the extremities of the object under examination; casts usually have round or club-shaped extremities.

4. Casts are colored by carmine solutions; vegetable elements, fungi, etc., are not so colored.

Bear in mind the fact that a urinary deposit may, and generally does, contain a mixture of two or more varieties of casts and cells, hence ground your opinion upon the variety which is most and best represented.

Remember (*a*) that epithelial casts often contain besides epithelial cells and red blood-corpuscles, white blood-cor-

puscles, pus-corpuscles, urates, uric acid and especially oxalate of lime crystals.

Remember (*b*) that in icteric complications all casts may be colored by bile or interspersed with urates or crystals (cleared by acetic acid).

Recognition of Spermatozoa.—Spermatozoa found in urine have no movement unless a very considerable amount of pus be present; they resist elements of destruction very successfully and may be found intact in putrid urine, of several months age. Ammonia rapidly destroys their form.

When present in the urine together with the seminal fluid a glairy, white deposit is found, but the spermatozoa themselves are not visible to the naked eye.

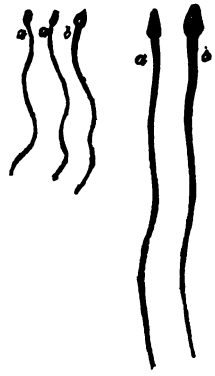


FIG. 21.—HUMAN SPERMATOZOA.
1.—350; 2.—800 diameters. *a*, viewed from the side; *b*, from the front.

Let the deposit settle as usual, dip in the pipette and place a drop on the slide; if there are many ingredients of the deposit interfering with a recognition of the spermatozoa add a little acetic acid if the deposit is phosphatic, or a little 10 per cent potassa solution if of urates. Use

FIG. 22.

1. Yeast fungi.—2. Penicillium glaucum.—3. Sarcina.—4. Cyst of the echinococcus with detached hooks.—Hofman and Ultzmann.

a power of 250 diameters first, in case only a few should happen to be present, afterward 400 to 600 diameters, to show them well. They have an oval or pear-shaped head or body and a long, extremely delicate, finely tapering tail. They are very refractive and of a peculiar bluish tint and, as it were, of a fatty lustre, hence most easily detected when viewed just outside of or beyond the exact focus. (Fig. 22.)

Fungi.—Any one inexperienced in the use of the micro-

scope may be misled by the appearance of certain organisms frequently found in urine and known as *fungi.*

Four varieties are of interest (Fig. 23): (i.) Sarcinæ; (ii.) bacteria; (iii.) penicilium glaucum; (iv.) torula cerevisiæ. The only fungi found in freshly-voided urine are those called *sarcinæ;* these are (Fig. 22 [3]) square bodies subdivided into secondary squares which number 2, 4, 8, etc., resembling those found in the vomited matter of persons suffering from stenosis of the pylorus although smaller.

After urine has been voided some little time other organisms may be found in it. *Penicilium glaucum* (Fig. 22 [2]) is the common blue mould found in vinegar and all albuminous fluids; when urine contains albumin a plentiful amount of this fungus may be found a few hours after it has been passed. Its *sporules* may be mistaken for blood-corpuscles, but if set aside for a few days they bud and the *thallus* is produced from which eventually spring the ascending stems of the *aerial fructification.* These fungi flourish in acid urine, but perish in alkaline. It will be remembered that fungi are not colored by carmine solutions, while casts, epithelia, etc., are. *Torula cerevisiæ* (Fig. 22 [1]) is the yeast or sugar fungus, but may be found in urine which contains no sugar; nevertheless, in diabetic urine it begins to form in a few hours, and is often developed in twenty to thirty-six hours after the urine has been voided, beginning as sporules and developing into thallus and aerial fructifications. It is difficult to distinguish torula cerevisiæ from penicilium glaucum until the aerial fructification has been reached, in which the torula has a globular head while the penicilium presents a tuft of branches.

When urine for any reason is decomposed, very delicate

bodies called *bacteria* may be seen, with a power of 200 diameters, exhibiting active motion, rotary or vibratory. A power of 500 diameters is required to show them well.

FIG. 23.—BACTERIA AND VIBRIONES.
From urine three days old; 403 diameters.—(Beale.)

Vibriones or vibrios (Fig. 23,) are filiform bodies, more or less distinctly jointed from imperfect division, and having an undulating movement like that of a serpent.

CLINICAL SUMMARY.

(Organized Deposits.)

Blood in the urine is significant of hæmorrhage somewhere in the urinary tract; it is found (i.) in the various forms of Bright's disease, (ii.) in bladder or urethral affections, (iii.) after the administration of certain drugs. It must be remembered that the urine of menstruating women or those suffering from uterine or vaginal hæmorrhage may contain blood. Urine containing blood will answer the tests for albumin. To tell whether albumin found in urine when blood is present be *kidney* albumin or simply that due to the presence of blood look for evidences of kidney disease; examine the urine for tube-casts, etc.

Blood coloring matter is found in the urine in certain diseases which accompany dyscrasia and blood degeneration, as in scurvy, putrid typhus, etc. *Temporary* presence of blood coloring matter in the urine is of no serious

import; when *permanently* found the prognosis is doubtful. Urine containing blood coloring matter has a color varying from red-brown to inky-black, and on boiling yields a brown-red coagulum.

Pus in the urine is significant of suppuration somewhere in or near the urinary tract; it may and most commonly does proceed from some local condition of the bladder. In women pus in the urine may be due to vaginal causes in which case an abundance of epithelium of the pavement variety may be seen with the microscope. An abscess bursting into the urinary passages will make itself known by the sudden presence of a large amount of pus in the urine. Urine containing pus will be found to contain albumin due to the pus; to differentiate from kidney albumin look for evidences of kidney disease as in case of Blood.

Mucus in abnormal quantity is indicative of irritation of the mucous membrane of the urinary passages. This irritation may develop into inflammation when it will occur mixed with pus. The amount of mucus is increased in fevers and acute diseases; after gonorrhœa long mucous "plugs" may be found in the urine. Irritation of the genital mucous membrane in women may cause considerable mucus to be found in the urine.

Epithelium in the urine may be found in increased quantity in the various diseases of the uro-poetic system. In female children of a strumous diathesis it is plentiful in the urine. An amorphous-looking, light, cloudy deposit abundant in quantity is frequently found in the urine of females, consisting of epithelial cells from the vagina; this deposit will be greatly increased in leucorrhœa.

Tube-casts are found in the urine in all cases of renal congestion and in acute or chronic Bright's disease. If

tube-casts are found in the urine for several weeks, it is well to examine the urine carefully for other constituents.

I. A plentiful amount of albumin with numerous casts, and renal epithelia or fatty cells strongly indicate Bright's disease; if the casts are granular or hyaline a grave disease of the substance of the kidney likely to assume a chronic course is indicated; if hyaline casts are present accompanied by the oily variety of granular casts the prognosis is unfavorable.

II. Pus and casts together indicate severe inflammatory process (pyorrhœa) either in the parenchyma of the kidney or in the calices and pelves.

III. Blood and casts indicate probably, a disease of the vessels of the kidney, such as fatty or amyloid degeneration of the renal arteries.

IV. If the casts contain daily a considerable amount of fat we may surmise fatty degeneration of the kidneys.

V. Casts of very small diameter may indicate narrowing of the renal tubules; casts of very large diameter may indicate dilatation of the renal tubules; casts of very unequal diameter, with bulgings and contractions, may indicate a varicose or distended condition of the renal tubules.

Spermatozoa may frequently be found in the urine of males in a state of health. Constant presence of them together with other symptoms may indicate that masturbation is practiced. They are found in the urine voided after coition or nocturnal emissions, during typhus, and in the so-called "spermatorrhœa."

Fungi are usually found in urine containing albumin or sugar, or that which has begun to decompose. Sarcinæ may be found in freshly voided urine in cases of vesical catarrh, dysuria, renal pains, dyspepsia, hypochondria.

Bacteria indicate that putrefactive changes in the urine have set in. Vibriones or vibrios may be found in the pale urine of cachectic and debilitated persons and those extremely prostrated by phthisis, mesenteric and syphilitic diseases.

NORMAL CONSTITUENTS.

After having ascertained the physical characteristics of urine, and examined it for abnormal constituents it is well after identifying the contents of any sediment to filter the urine and test it for its normal constituents.

Detection of Urea.—No simple qualitative test for urea is known, but all operations tend to show the *amount* of urea present in the urine. The following method has been recommended as sufficiently accurate for practical purposes in determining the amount of urea present in a given specimen of urine:

Upon a glass slide place a drop or two of the urine at ordinary temperature and add to it an equal quantity of concentrated nitric acid; if crystals (urea nitrate) form at once or within five minutes, there is an *excess* of urea. If the crystals form in from five to ten minutes the amount of urea is *normal*. If the crystals do not form in ten minutes there is a *deficiency* of urea.

In cases where it is desirable to know the amount of urea excreted in a day collect the urine for twenty-four hours and estimate the urea by the method of Fowler.

Fowler's Method for the Estimation of Urea.—Obtain some standard solution of chlorinated soda (Squibb) and proceed as follows:

(i.) Take the specific gravity of the twenty-four hours urine and of the chlorinated soda solution, separately.

Add the specific gravity of the urine to that of the soda solution after multiplying the latter by 7; for example suppose the specific gravity of the urine to be 1015 and that of the soda solution 1048; $1048 \times 7 = 7336$; add 7336 to 1015 and we have 8351. Next divide the same by 8—in this case $8351 \div 8 = 1044$, nearly. Then mix 15 parts of the urine, say 15 cubic centimetres, with 105 parts of the soda solution, say 105 cubic centimetres, shake well and let stand for at least two hours, after which take the specific gravity and subtract it from the result of the division by 8. The difference multiplied by 3.55 will give the number of grains of urea to each fluid ounce of urine under examination (the difference multiplied by 7.791 will give the number of milligrams of urea to the cubic centimetres of urine). Further multiplication by the total number of ounces of urine passed during the twenty-four hours will give the total amount of urea in grains. Thus, suppose in the case mentioned above, after mixing, the specific gravity was found to be 1041; subtract this 1041 from 1044 (the result of the division by 8) and the difference is 3. Multiply 3 by 3.55 and we find 10.65 grains of urea to the ounce. Suppose 40 ounces of urine were passed during the twenty-four hours—then 10.65 multiplied by $40 = 426$ grains of urea voided in twenty-four hours.

It is evident that with this method we must be able to fix the point at which the urinometer floats in the several liquids with nicety. When these liquids are perfectly transparent there is no difficulty, the proper way being to read from the under surface of the fluid bringing the eye on a level with that surface. When the urine from any cause is opaque either filter it carefully or resort to the following simple device recommended by Fowler: Take a

piece of soft pine and shape it into a circular disk somewhat smaller than the calibre of the smallest cylinder to be used. Make it exceedingly thin and uniform and perforate it in the centre with a round hole which will freely accommodate the stem of the urinometer. Having put the stem of the instrument through this opening and immersed it in the fluid, the bit of wood will float on the surface, and the specific gravity can be readily taken by noting the point at which the float comes in contact with the stem. The weight of the wood will cause a slight increase in the specific gravity, but when used in every case the error will be the same and correct itself.

Detection and Estimation of Sodium chloride.—Filter the urine, fill a clean test-tube half full of it, add two or three drops of nitric acid, and a liberal amount of silver nitrate solution; a heavy white precipitate of a cheesy appearance (silver chloride) soluble in ammonia indicates presence of salt in the urine. In acute diseases the more abundant this precipitate as a rule the more favorable the indication; care must be taken to add a few drops of nitric acid *always* before adding the silver nitrate as this prevents the precipitation of silver phosphate. If the urine to be tested contain albumin heat, add a few drops nitric acid, filter and to the filtered urine add silver nitrate. To estimate roughly the *amount* of salt in urine from day to day collect the urine for twenty-four hours and filling a test-tube exactly half full add two or three drops of nitric acid, then, drop by drop, a solution of silver nitrate (strength 1 in 10) stirring after each drop with a glass rod until no further precipitate forms on adding the nitrate. Set the tube aside and on the next day repeat the operation just described, remembering to use a test-tube of the same size as on the preceding day. After the precipitate has settled

to the bottom of the tube it may be compared in bulk with that of the preceding day.

Detection of Sulphates.—Fill a clean test-tube half full of urine, add a few drops of hydrochloric acid then some solution of barium chloride; a white precipitate which is not dissolved on further addition of nitric acid indicates presence of sulphates.

Detection of Phosphates.—If the urine be clear, containing no sediment, and of acid reaction, fill a test-tube half full of it, add ammonia and heat. A flocculent precipitate appearing indicates presence of *earthy phosphates*; filter the urine and to the filtrate add solutions of ammonium carbonate and magnesium sulphate. White flocculent precipitate indicates presence of *alkaline* phosphates. (When the *earthy phosphates* form a sediment or deposit proceed as under Deposits; the methods just mentioned are merely given to enable the physician to tell whether a given specimen of urine contains phosphates in fair amount or not).

Estimation of Phosphates.—In most cases a study of the variations in amount of the earthy phosphates will be a sufficient clinical guide.

Obtain a specimen of normal urine—preferably a sample of the mixed urine of twenty-four hours—and after filtering it place 10 cubic centimetres into a tube or glass jar and add to it 5 cubic centimetres of ammonia. Agitate thoroughly as before and allow the mixture to rest. The next day observe the height of the precipitate in the tube; if the latter be graduated, say into fifths of a cubic centimetre, the accuracy of the operation will be greatly increased. Having thus observed how heavy a precipitate forms in the normal urine apply the same method of procedure to a specimen of supposed abnormal, and a great

excess of earthy phosphates in the latter will be indicated by a great comparative height of the precipitate in the tube. To obtain satisfactory results a specimen of the urine of twenty-four hours should, in each case, be used; for instance, suppose the normal urine used were that passed after drinking three or four glasses of water, and the abnormal that passed on rising in the morning—to draw any conclusions from the comparison of two such widely differing specimens would be absurd. For further consideration of phosphates see Deposits.

Detection of Urates.—This may be accomplished by adding to ten parts of urine one part of hydrochloric acid. Allow the mixture to stand thirty hours in a cool place when crystals of uric acid will form, recognized by the naked eye or by the microscope. See Uric acid Deposits.

Detection of Coloring Matter.—(1) Fill a clean test-tube half full of urine and allow twenty or thirty drops of nitric acid to trickle down the sides of the tube into the urine; when the acid and urine meet a zone of light pinkish-red color will be observed, indicating presence of *uro-hematin.* The darker the zone the more the uro-hematin. The color is best observed by holding against a white object. (2.) Fill a clean test-tube half full of urine and allow twenty or thirty drops of pure hydrochloric acid to trickle down its sides. Where the urine and acid meet a zone of violet color gradually developing itself indicates presence of *indican;* the more the indican the bluer the color of the zone.

Detection of Mucus.—Where mucus is not visible on careful examination addition of acetic acid to the urine will coagulate the mucin and render it plainer to the eye.

Detection of Creatinin and of Hippuric acid.—Creatinin is only detected by a long chemical process not suitable to

describe here. The same may be said of hippuric acid. See Rare Deposits.

CLINICAL SUMMARY.

(Normal Constituents.)

Urea is *increased* in acute febrile states and in diabetes; it is *decreased* in Bright's disease and in long-continued organic diseases in general.

Sodium chloride is *decreased* (sometimes absent) in acute diseases, especially inflammations attended by exudations, as pneumonia.

The Sulphates are of little clinical importance.

The Phosphates may be *increased* in inflammatory diseases of the nervous system and in cases of nerve lesions in general; also in certain cases of diabetes. They may be *decreased* in Bright's disease.—Brattler.

The Urates are similar in significance, when not found as a deposit, to urea.

Urohematin is *increased* in acute febrile disorders and often in diabetes; it is diminished usually in anæmia and chlorosis.

Indican may be increased in the urine of persons far advanced in phthisis, or suffering from cancer.

EXAMINATION OF URINARY CALCULI.

To make a thorough and systematic examination of urinary calculi one has need of a jeweler's saw and agate mortar, platinum foil, several watch glasses, an alcohol lamp and a good knife with small, sharp blades, together with various reagents. See Part II.

An approximate idea of the most important calculi may be gained from the following:

Uric acid calculi are relatively very common and may reach a very considerable size. They are usually yellowish, reddish, or red-brown, rarely white, and generally have a smooth surface and are tolerably hard.

Phosphatic calculi may be of considerable size; they usually have a whitish color and are soft, porous and chalky or denser and harder according to the particular phosphate which predominates in them.

Oxalate of Lime calculi are tolerably frequent, especially in children. They are either small, pale, and smooth—*hemp seed calculi*—or are larger, of rough exterior, tuberculated, warty and colored on the surface, usually dark brownish or even blackish—*mulberry calculi.*

Carbonate of Lime calculi are rare but are easily detected by the property of dissolving with effervescence in hydrochloric acid.

PART II.

CLINICAL SIGNIFICANCE OF URINE.

NORMAL URINE.

Average Composition of Normal Urine in 1,000 Parts.—

Water,	949.25
Solids,	50.75
Total,	1000.00

Organic.

Water,	949.35
Urea,	26.00
Creatin,	traces
Creatinin,	1.50
Urates of Sodium and Potassium,	1.75
Free Uric acid,	traces
Mucus and coloring matter,	0.25

Inorganic.

Acid Phosphate of Sodium, Phosphates of Calcium and Magnesium,	6.25
Chlorides of Sodium and Potassium,	9.25
Sulphates of Sodium and Potassium,	5.75
Total,	1000.00

Normal Urine.—Normal urine is a clear liquid of a color varying from light straw to reddish yellow, possessed

of an odor peculiar to itself and consisting chiefly of water holding various substances for the most part in solution, such as urea, common salt, phosphates, etc.

Quantity of Normal Urine in Twenty-four Hours.—In general terms the healthy adult passes from forty to sixty fluid ounces of urine during the twenty-four hours.

Observations of the Author on the Quantity of Urine Passed Daily.—Having had opportunity to measure the daily quantity of urine passed by an adult man in good health, I give the result of sixty-eight successive daily measurements as follows:

1st	day,	-	-	-	-	1008	cubic	centimetres.
2d	"	-	-	-	-	1100	"	"
3d	"	-	-	-	-	705	"	"
4th	"	-	-	-	-	1625	"	"
5th	"	-	-	-	-	1135	"	"
6th	"	-	-	-	-	1104	"	"
7th	"	-	-	-	-	897	"	"
8th	"	-	-	-	-	1540	"	"
9th	"	-	-	-	-	1120	"	"
10th	"	-	-	-	-	1592	"	"
11th	"	-	-	-	-	952	"	"
12th	"	-	-	-	-	898	"	"
13th	"	-	-	-	-	1188	"	"
14th	"	-	-	-	-	901	"	"
15th	"	-	-	-	-	1186	"	"
16th	"	-	-	-	-	1183	"	"
17th	"	-	-	-	-	1901	"	"
18th	"	-	-	-	-	1476	"	"
19th	"	-	-	-	-	1610	"	"
20th	"	-	-	-	-	1553	"	"
21st	"	-	-	-	-	1326	"	"
22d	"	-	-	-	-	911	"	"

23d day,	- - - -	1580	cubic centimetres.
24th "	- - - -	965	" "
25th "	- - - -	1885	" "
26th "	- - - -	1283	" "
27th "	- - - -	975	" "
28th "	- - - -	1106	" "
29th "	- - nearly	1250	" "
30th "	- - "	1300	" "
31st "	- - "	1100	" "
32d "	- - "	1200	" "
33d "	- - "	1500	" "
34th "	- - "	1500	" "
35th "	- - "	1300	" "
36th "	- - "	1250	" "
37th "	- - "	1600	" "
38th "	- - "	750	" "
39th "	- - "	1700	" "
40th "	- - "	900	" "
41st "	- - "	1600	" "
42d "	- - "	900	" "
43d "	- - "	1300	" "
44th "	- - "	2200	" "
45th "	- - "	1600	" "
46th "	- - "	1700	" "
47th "	- - "	1200	" "
48th "	- - "	1500	" "
49th "	- - "	1000	" "
50th "	- - "	1600	" "
51st "	- - "	1300	" "
52d "	- - "	1200	" "
53d "	- - "	1200	" "
54th "	- - "	1000	" "
55th "	- - "	1500	" "

56th day,	- -	nearly	1200	cubic	centimetres.
57th "	- -	"	1200	"	"
58th "	- -	"	1325	"	"
59th "	- -	"	1025	"	"
60th "	- -	"	900	"	"
61st "	- -	"	1200	"	"
62d "	- -	"	1300	"	"
63d " morning and night only			600	"	"
64th "	- - - -		1200	"	"
65th "	- - - -		1400	"	"
66th "	- - - -		1200	"	"
67th "	- - - -		1300	"	"
68th "	- - - -		1400	"	"

During the first twenty-eight days the measurements were made with close accuracy; during the last forty days the quantity was measured and the results given in round numbers.

Daily average for first 28 days, 1249.46 c. c.
" " " last 39 days, 1300 " " (nearly).
Greatest quantity voided on any day 2200 c. c.
Least " " " " " 705 " "

On the sixty-third day owing to unavoidable circumstances, only the urine passed in the morning and at night was collected, amounting to 600 cubic centimetres; the quantity for that day is therefore omitted in making up the averages.

During the sixty-eight days, when the daily amount was being collected and measured, a routine life was led, late hours avoided, and no alcoholic liquors of any kind taken, and every care observed that one day should be as nearly alike another as possible. The diet was as nutritious and hearty as compatible with a sedentary life, indigestible food being carefully shunned. The only fluids taken

were cold water (without ice) between meals, and at meals very weak tea; no coffee was drank during the entire period and the tea was made as weak as was possibly palatable. A small amount of very mild tobacco was smoked after lunch and after dinner, the latter being at six o'clock. It would appear, therefore, that a healthy, well-nourished, male adult, leading a quiet life and not drinking much, passes on an average from 1250 to 1300 cubic centimetres of urine daily, or about forty-two fluid ounces. Persons of active temperaments and strong constitutions may pass, normally, considerably more than forty-two fluid ounces; in fact, various conditions affect the daily quantity of urine in the healthy individual as follows:

Circumstances not due to disease or drugs increasing the amount of urine.

I. Activity of the kidneys: greater during bodily and mental activity and less during rest and sleep.

II. Copious drinking of fluids, especially when little perspiration.

III. Cold, damp weather (little perspiration).

IV. Animal diet: nitrogenous food in general.

V. Non-retention in bladder for any length of time.

VI. Age and sex: children *relatively* more than adults; males than females.

Circumstances not due to disease or drugs decreasing the amount of urine.

I. Inactivity of kidneys: during rest and sleep or abstinence from mental or physical exertions.

II. Abstinence from drinking.

III. Activity of cutaneous and pulmonary exhalations, (after exercising accompanied by profuse perspiration, urine scanty).

IV. Warm, dry weather: (much perspiration).

V. Non-nitrogenous diet.

VI. Retention in the bladder for some time: (reabsorbed into the circulation).

VII. Age and sex. (See above).

Quantity of Urine Passed at Different times in the day.—The urine passed on rising in the morning is called *urina sanguinis*, that after a meal *urina cibi* or *chyli*, that after drinking *urina potus*.

When the daily quantity for sixty-eight days was collected account was kept of the urine voided at different times in the day for the first twenty-eight days as follows:

1st day, urina sanguinis,	178	cubic centimetres.
12 noon,	55	"
1.30 P. M.,	100	"
6.30 "	400	"
10.30 "	275	"

Number of urinations, 5.

2d day, sanguinis,	125	cubic centimetres.
3.30 P. M.,	475	"
10.30 "	400	"

Number of urinations, 3.

3d day, sanguinis,	150	cubic centimetres.
12 noon,	175	"
3.30 P. M.,	110	"
6.00 "	100	"
10.30 "	170	"

Number of urinations, 5.

4th day, sanguinis,	275	cubic centimetres.
1.00 P. M.,	200	"
3.30 "	460	"
6.00 "	175	"
11.00 "	515	"

Number of urinations, 5.

5th day, sanguinis, - - - - 220 cubic centimetres.
1.00 P. M., - - - 160 "
3.30 " - - - 155 "
5.30 " - - - 200 "
11.00 " - - - 400 "
Number of urinations, 5.

6th day, sanguinis, - - - - 245 cubic centimetres.
1.00 P. M., - - - 185 "
3.30 " - - - 337 "
10.00 " - - - 337 "
Number of urinations, 4.

7th day, sanguinis, - - - - 337 cubic centimetres.
2.30 P. M., - - - 160 "
10.30 " - - - 400 "
Number of urinations, 3.

8th day, sanguinis, - - - - 305 cubic centimetres.
3.00 P. M., - - - 135 "
7.00 " - - - 400 "
9.30 " - - - 700 "
Number of urinations, 4.

9th day, sanguinis, - - - - 280 cubic centimetres.
1.00 P. M., - - - 125 "
3.30 " - - - 275 "
6.30 " - - - 160 "
11.00 " - - - 280 "
Number of urinations, 5.

10th day, sanguinis, - - - - 337 cubic centimetres.
12 noon, - - - - 175 "
3.30 P. M., - - - 345 "
6.30 " - - - 350 "
11.00 " - - - 385 "
Number of urinations, 5.

11th day, sanguinis, - - - - 130 cubic centimetres
12.30 P. M., - - - 95 "
3.30 " - - - 366 "
4.30 " - - - 83 "

10.00 P. M., - - - - 278 cubic centimeters.

Number of urinations, 5.

12th day, sanguinis, - - - - 260 cubic centimetres.
2.00 P. M., - - - 140 "
7.30 " - - - 278 "
10.00 " - - - 220 "

Number of urinations, 4.

13th day, sanguinis, - - - - 278 cubic centimetres.
11.00 A. M., - - - 80 "
2.00 P. M., - - - 270 "
4.30 " - - - 290 "
10.00 " - - - 270 "

Number of urinations, 5.

14th day, sanguinis, - - - - 330 cubic centimetres.
12 noon, - - - - 140 "
10.30 P. M., - - - 431 "

Number of urinations, 3.

15th day, sanguinis, - - - - 278 cubic centimetres.
3.30 P. M., - - - 278 "
6.30 " - - - 225 "
9.00 " - - - 475 "

Number of urinations, 4.

16th day, sanguinis, - - - - 278 cubic centimetres.
12 noon, - - - - 100 "
6.00 P. M., - - - 580 "
11.30 " - - - 225 "

Number of urinations, 4.

17th day, sanguinis, - - - - 278 cubic centimetres.
12 noon, - - - - 225 "
3.30 P. M., - - - 813 "
6.30 " - - - 425 "
10.15 " - - - 160 "

Number of urinations, 5.

18th day, sanguinis, - - - - 333 cubic centimetres.
12 noon, - - - - 195 "

3.30 P. M., - - - - 278 cubic centimetres.
6.30 " - - - - 520 "
10.00 " - - - - 150 "

Number of urinations, 5.

19th day, sanguinis, - - - - - 361 cubic centimetres.
12 noon, - - - - - 160 "
3.30 P. M., - - - - 603 "
6.00 " - - - - 323 "
10.30 " - - - - 163 "

Number of urinations, 5.

20th day, sanguinis, - - - - - 340 cubic centimetres.
12 noon, - - - - - 180 "
3.30 P. M., - - - - 338 "
6.00 " - - - - 417 "
11.00 " - - - - 278 "

Number of urinations, 5.

21st day, sanguinis, - - - - - 378 cubic centimetres.
12 noon, - - - - - 278 "
6.30 P. M., - - - - 325 "
11.00 " - - - - - 345 "

Number of urinations, 4.

22d day, sanguinis, - - - - - 278 cubic centimetres.
4.00 P. M., - - - - - 310 "
6.00 " - - - - - 90 "
11.00 " - - - - - 233 "

Number of urinations, 4.

23d day, sanguinis, - - - - - 255 cubic centimetres.
12 noon, - - - - - 170 "
3.30 P. M., - - - - - 650 "
6.30 " - - - - - 320 "
10.00 " - - - - - 185 "

Number of urinations, 5.

24th day, sanguinis, - - - - - 300 cubic centimetres.
12 noon, - - - - - 175 "
6.30 P. M., - - - - - 300 "
10.30 " - - - - - 190 "

Number of urinations, 4.

25th day, sanguinis, - - - - 390 cubic centimetres.
12 noon, - - - - 200 "
3.30 P. M., - - - 745 "
6.15 " - - - 350 "
10.30 " - - - 200 "

Number of urinations, 5.

26th day, sanguinis, - - - - 300 cubic centimetres.
12 noon, - - - - 175 "
3.30 P. M., - - - 400 "
6.30 " - - - 175 "
10.30 " - - - 133 "

Number of urinations, 5.

27th day, sanguinis, - - - - 300 cubic centimetres.
6.30 P. M., - - - 500 "
10.00 " - - - 175 "

Number of urinations, 3.

28th day, sanguinis, - - - - 400 cubic centimetres.
12 noon, - - - - 100 "
4.00 P. M., - - - 200 "
11.00 " - - - 400 "

Number of urinations, 4.

SUMMARY.

Average number of urinations, daily, - - - - 4 to 5.
Average quantity voided at each urination, - 282.1 c. c.
Greatest quantity voided at any one urination, 813.0 "
Least quantity voided at any one urination, - 55.0 "
Average quantity of urina sanguinis, - - - 282.7 "
Average quantity passed before retiring, - - 299.0 "

The urine passed before retiring was in in each case, as a rule, *urina cibi*, the principal meal of the day occurring at 6 P. M.

The greatest quantity of urine voided at any one urination, 813 cubic centimetres, at 3.30 P. M., on the 17th day, was combined *urina cibi* (after lunch at 12.45) and

urina potus — three glasses of water having been drunk between the hours of 2 and 3 P. M.

Specific Gravity.—The specific gravity of normal urine is said to lie on an average between 1015 and 1025.

Circumstances not due to disease or drugs increasing the relative amount of solids in the urine, i. e., increasing the specific gravity;

I. Time of day: urina sanguinis.

II. Hearty meals, after: urina chyli.

III. Causes decreasing the quantity of fluid.

Circumstances not due to disease or drugs decreasing the specific gravity.

I. Copious draughts of fluids (urina potus).

II. Causes *increasing* the quantity of fluid.

The specific gravity of urina sanguinis should be from 1015 to 1025; of urina cibi, 1020 to 1030; that of urina potus, 1015 to 1002.

Solid Constituents.—The urine of an healthy adult contains dissolved in it from sixty to seventy grammes (925 to 1075 grains) of solid matters, urea, salts, etc., during the twenty-four hours.

The method of calculating the amount of solid matters contained in the urine of twenty-four hours is:

I. Collect the urine for twenty-four hours.

II. Measure it in cubic centimetres by means of a flask graduated in cubic centimetres.

III. Divide the amount of cubic centimetres found, by 1000 and set the result aside for the moment.

IV. Take the specific gravity of the urine.

V. Multiply the last two figures by 2.—Trapp's Coefficient.

VI. Multiply the result by the figure found in (III.

and the product will be the amount of solids (in grammes) in the urine of twenty-four hours.

VII. To find the number of grains multiply this product by 15.4

EXAMPLE I.

Amount of urine 3000 cubic centimetres in twenty-four hours.

$$3000 \div 1000 = 3. \quad \text{(III.)}$$

Specific gravity of urine, 1008. $08 \times 2 = 16$. $16 \times 3 = 48$. This urine therefore contains 48 *grammes* of solid matters; $48 \times 15.4 = 739.2$ *grains*.

EXAMPLE II.

Amount of urine in twenty-four hours, 760 cubic centimetres.

$$760 \div 1000 = .76. \quad \text{(III.)}$$

Specific gravity of urine 1030. $30 \times 2 = 60$. $60 \times .76 = 45.6$. This urine contains then 45.6 grammes solid matters or (45.6×15.4) 702.2 grains.

Consistence.—Normal urine is a thin, easily dropping fluid, foaming if shaken; this foam vanishes soon on standing.

Transparence and Fluorescence.—Normal urine is always clear and transparent, showing, after standing at rest for some time, a very slight turbidity or light, grayish-white cloud which gradually settles to the bottom of the vessel. This cloud, called nubecula, is derived from the bladder and is composed mainly of mucus and epithelial cells; it is generally more apparent in the urine of women than that of men, but should never be sufficiently visible to attract attention. Normal urine shows at times a peculiar white fluorescence.

Color.—The color of normal urine varies from pale straw, or almost colorless after copious draughts of water,

through yellow to red, after hearty meals or free perspiration; the standard "normal" color as in winter, is wine yellow or amber, called by some "sherry color".

Odor.—The odor of fresh, normal urine is slightly aromatic, and is called *"sui generis"*—peculiar to itself.

The odor is stronger in proportion to the amount of solids contained in the urine. The urine passed after a hearty meal smells stronger than that after copious draughts of water. The urine of infants is generally inodorous but on standing acquires the agreeable savor of veal broth.

Urine, on standing exposed to the air for some time, loses its *sui generis* odor and takes on, first, a smell somewhat like that of sour milk and, subsequently, a fetid ammoniacal odor.

Reaction.—Normal urine of twenty-four hours turns blue litmus paper dipped into it slightly red; after a meal it may turn neither blue litmus paper red, nor red litmus paper blue; after a meal or after a cold bath it may turn red paper blue. In other words, normal urine is slightly acid in reaction; it may be neutral or alkaline after meals, or alkaline after a cold bath. Vegetable diet tends to make urine neutral.

ABNORMAL URINE.

(Physical Characteristics.)

The quantity, specific gravity, solids, consistence, color, transparence, odor, and reaction of normal urine being known it is now in order to study the departures from normal standards shown in the physical characteristics of abnormal urine.

Increased Quantity of the Twenty-four Hours Urine.—

A large increase in the total amount of urine for twenty-four hours is indicative of diabetes, either mellitus or insipidus, especially if the daily increase of quantity above normal is persistent, and on calculation we find the amount of solids likewise increased.

In diabetes mellitus the daily amount of urine voided may be enormous.

In case the total amount of urine for twenty-four hours is *increased* (above normal) while the solid matters are *below* normal in amount, increase of the *water* in the urine is indicated, which is called *hydruria*, and is neither diabetes mellitus nor diabetes insipidus. Cases of this sort have been noticed in rheumatism, the daily amount averaging 3000 cubic centimetres (about three quarts) while the average amount of solid constituents was only 42 grammes (647 grains). "In such cases no emaciation results, but, on the contrary, diseased products are often removed, as in many cases of hydræmia and dropsy".

Lastly, when the amount of urine is in excess of normal and the quantity of solid matters passed remains within normal limits we ought to suspect a large amount of fluids to have been drunk.

An increase above normal limits in the total amount of urine for twenty-four hours is called *polyuria;* polyuria may be divided into two classes: increase in amount of urine, with *increase* in solids, called *diabetes* (two forms "mellitus" and "insipidus") and increase in amount of urine, with *decrease* in solids, called *hydruria.*

The word *polyuria* is derived from two Greek words signifying "much urine"; the word *hydruria*, "watery urine"; or "flow of much urine" and "flow of watery urine" respectively.

It will be borne in mind that an increased amount of

urine due to excessive drinking is called "urina potus," is not pathological since the amount of solids does not exceed normal limits in either direction, and does not come under the head of *polyuria*.

Diabetes, the first form of polyuria, in which the amount of the solids is increased, may be of two forms: diabetes mellitus and diabetes insipidus.

Diabetes *mellitus* (mellitus from *mel* "honey") is saccharine diabetes, i. e., diabetes where sugar is present in the urine; diabetes *insipidus* (insipidus from *in* and *sapor*, "tasteless") is diabetes where sugar is absent but an abnormally large amount of other solids present in the urine.

The word *diabetes* then means "increased flow of urine with increased excretion of solid matters," whether sugar and normal constituents (in which case the qualifying term "mellitus" is added) or normal constituents *without* sugar (in which case the term "insipidus" is used).

Diabetes of any kind is accompanied by weakness and emaciation; *hydruria* is not accompanied by either of these.

Urine in Bright's Disease.—In certain forms of Bright's disease, namely, in interstitial nephritis and in amyloid degeneration of the kidney the amount of urine is largely increased—even to three or four times the normal quantity; just before death, however, the quantity falls below normal.

Temporary Increase in Amount of Urine.—Temporary increase of urine is noted after hysterical paroxysms and other convulsive attacks in both males and females.

Increased Tension.—Any increase of tension in the arterial system as in some cases of hypertrophy of the left ventricle of the heart will tend to cause an increase in the quantity of urine.

Decreased Quantity of Twenty-four hours.—Leaving the cases where the urine in amount *exceeds* the normal limit for twenty-four hours and turning our attention to a *decreased* amount we find that "*at the height of all acute febrile diseases* the quantity of urine is considerably diminished."

Moreover the quantity of urine passed daily in acute disease gives us important indications: "*A constant daily diminution of the quantity of the urine indicates that the intensity of the disease is increasing—a continued low quantity of the urine* (*below* 800 *cubic centimetres, or* 1⅝ *pints per diem*) *shows that the intensity of the disease has not diminished—while a steady increase of the quantity of urine shows that the force of the disease has been broken.*" —Vogel.

During convalescence the quantity of urine becomes normal or may even exceed that limit.

In the paroxysms of intermittent fever, i. e., during the *chill*, the quantity of urine is not always scanty, nor is it always in the acute rheumatism of childhood where there is mitral insufficiency or hydræmia.

In *typhus* fever, a profuse flow of normal urine is sometimes noticed at the height of the disease.

Wilson says that in *cerebro-spinal* fever the quantity may be much increased even when the fever is active and the temperature high.

The above are the principal exceptions to the general rule of the quantity of urine in fevers, and should be carefully noted.

In general all types of violent fever and inflammation are likely to be attended by suppression of the urine, as scarlatinal nephritis and yellow fever; suppression of urine is noted also in the collapse of cholera, in later

stages of organic diseases of the kidneys, and when any mechanical obstacle obstructs the flow of urine, as after catheterism. The urine is scanty in amount in cirrhosis of the liver and in scurvy. Any condition of the heart leading to passive congestion of renal veins, by which the circulation through the kidneys is impeded, will diminish the amount of urine. After copious vomiting or abundant watery stools the urine is diminished.

Urine in Bright's Disease.—The quantity of urine is diminished in some forms of Bright's disease: (i.) in the *early stages* of acute parenchymatous nephritis, (ii.) in chronic parenchymatous nephritis, (iii.) in interstitial nephritis or amyloid degeneration if complicated with acute or chronic parenchymatous nephritis according to the extent of the parenchymatous complication, (iv.) in the last stages of all forms.

Effect of Drugs on the Quantity of Urine.—Administration of the so-called diuretics, such as acetate of potassium, spiritus aetheris nitrosi, etc., will *increase* the quantity of the urine; also inhalation of oxygen, chronic lead-poisoning (irregular transitory polyuria), etc.

Mineral salts such as those of iron and copper *decrease* the amount of urine; potassium chlorate when given in small doses will increase the amount, but in heavy doses will first suppress the urine and then cause an abundant flow of bloody albuminous urine. The urine is decreased in poisoning from external use of pyrogallic acid (Meisser), of aniline compounds, and of atropin (as a collyrium); in poisoning from phosphorus taken internally.

The urine is decreased, often to suppression, in poisoning from, or after heavy doses of, cantharides, arsenic, carbolic acid, ergot, iodine, mercury, opium.

Specific Gravity.—In drawing conclusions from the spe-

cific gravity of urine the *quantity* for twenty-four hours must be considered. Urine of high specific gravity, (above 1025), but *small* in quantity and heightened in color is characteristic of a *febrile* condition, bearing in mind the fact that abstinence from drinking coupled with profuse perspiration will cause similar conditions. Urine of high specific gravity with *increased* amount in twenty-four hours, especially if continuing for some time, is characteristic of diabetes mellitus. Urine of *lowered* specific gravity and *increased* amount is characteristic of diabetes insipidus. (In dropsy or hydræmia a large amount of urine low in specific gravity is a favorable sign and should not be confounded with the conditions obtaining in diabetes insipidus).

Lastly, and most important to the practitioner, if the daily quantity of urine is small and the specific gravity lower than normal we have reason to fear uræmia; conditions of this kind frequently indicate an alterati of the kidneys as observed in Bright's disease. It must be observed that the rules given above are for the majority of cases; in diabetes insipidus the specific gravity is not always below normal, and cases of diabetes mellitus have been observed where the specific gravity was not remarkably high.

Summary for Specific Gravity.—Urine is pathological if the quantity for twenty-four hours being collected we observe:

(i.) Specific gravity high, color high, quantity small.

(ii.) Specific gravity high, color pale, quantity large.

(iii.) Specific gravity low, color of deep tint, quantity large.

(iv.) Specific gravity low, urine more or less colorless, quantity small.

The urine for twenty-four hours having been collected on different occasions if we observe:

(i.) Specific gravity persistently below 1015, suspect albuminuria.

(ii.) Specific gravity persistently below, say, 1008, suspect diabetes insipidus.

(iii.) Specific gravity persistently above 1025, color pale, suspect diabetes mellitus.

(iv.) Specific gravity persistently above 1025, color high, suspect febrile state.

EXAMPLE.

CASE 1.—Quantity in twenty-four hours averages 900 cubic centimetres ($\frac{9}{10}$ qt.). Specific gravity averages 1030 to 1035. Color always high. The case is one of severe fever.

CASE 2.—Quantity in twenty-four hours averages daily 4800 cubic centimetres (5 qts. nearly). Specific gravity averages daily 1025 to 1035. Urine contains sugar. Diagnosis, diabetes mellitus.

CASE 3.—Quantity in twenty-four hours averages daily 3500 cubic centimetres ($3\frac{1}{2}$ qts.). Specific gravity averages daily about 1015. No sugar found in the urine and the case is one of diabetes insipidus.

CASE 4.—Quantity in twenty-four hours averages 600 cubic centimetres ($1\frac{1}{8}$ pints). Specific gravity averages 1010. The case is one of chronic Bright's disease.

The above cases are given merely to illustrate principles and are by no means intended to serve as sole guides to diagnosis.

Solids.—If the daily amount of solids is persistently increased, when at the same time the patient is not living on animal food chiefly, or animal broths, destruction of the tissues of the body, excessive in nature, may be indi-

cated. In drawing conclusions in regard to the amount of solid matters, consider also the quantity of urine daily, and the specific gravity.

CASE 1.—Quantity, daily, averages 4000 cubic centimetres; specific gravity, daily, averages 1007; solids (estimated by method on page 91,) 56 grammes (862 grains). The amount of solids is nearly normal but the quantity and specific gravity of the urine are abnormal—in other words, the *fluid* has been increased in amount, and either excessive drinking, on the part of the person, may be indicated, or, if he be suffering from dropsy or hydræmia, the system is endeavoring to throw off the surplus fluid and the condition of the urine is a favorable sign.

CASE 2.—Quantity, daily, averages 6000 cubic centimetres (six quarts); specific gravity, daily, averages 1014; solids, 168 grammes (2,587 grains). The solids are largely increased, likewise the fluid, and some form of diabetes may be indicated. Testing the urine for sugar, in the manner hereafter to be described, would tell us which form of diabetes was present, care being taken, if sugar be found, to test the urine repeatedly for it for sometime afterward.

If urine of normal or decreased quantity daily, of low specific gravity and decreased amount of solids, occur, we may suspect some impediment to the secretion of urea and have reason to fear the results of retention of urea in the body (uræmia).

We find in most chronic diseases except diabetes, the daily amount of solids decreased; an increase of them is then, as a rule, a sign of more favorable conditions, such as more active metamorphosis or better nutrition, while, on the other hand, an increase of the solid matters at the

height of an acute disease is usually an unfavorable sign, because the inanition which always occurs in such cases is thereby increased and favored. (Vogel.)

Lastly, in the case of a patient who, on account of a febrile disorder has fasted or taken but little food, we must not deem sixty or seventy grammes (924 to 1078 grains) of solids computed from the amount and the specific gravity to be by any means normal, but largely in excess. When we say that sixty to seventy grammes is the normal amount per diem, we of course presuppose ordinary health and ordinary diet. In the case of a person suffering from an acute febrile disorder, 30 grammes (462 grains) will be an average amount, and if this rises to 40 or 50 (616 to 770 grains), on a strict and careful diet, it is at the expense of the body and is an unfavorable sign.

In chronic lead-poisoning the amount of solids is greatly reduced.

Summary: (i.) Increased quantity, decreased specific gravity, with normal amount of solids, simply means increase in fluid, and may be physiological or occur in certain cases of dropsy; (ii.) Increased quantity, normal, increased or even decreased specific gravity with increased solids, indicates diabetes; (iii.) Normal or diminished quantity, diminished specific gravity and diminished amount of solids, means often uræmia, and may occur in Bright's disease.

Color.—Urines of abnormal color may be classified as follows:

I. Nearly colorless: neuroses.

II. Watery urine and diabetic urine showing slight tinge of yellow, which on standing may become darker.

III. High-colored urine, color dark yellow to red or even flame red, found in acute febrile disorders.

IV. Blood-red urine, caused by foreign coloring matter or by the passage of blood into the urine.

V. Dark brown to nearly black urine in (i.) kidney diseases, especially hæmorrhages, when (ii.) bile coloring matters enter the urine, in (iii.) long-continued intermittent fever.

VI. Green urine, dirty in hue, in jaundice when bile coloring matter is present in the urine — so-called "icteric" urine.

VII. Dirty-blue urine chiefly in cholera and typhus (see page 104).

In familiar language, the abnormal colors shown by urine or its sediments may be classified as follows:

"Smoky" colored urine: due to presence of blood.

White urine: due to presence of pus, spermatozoa or chyle.

Black urine: due to presence of (i.) melanin, or to (ii.) drugs, or found in (iii.) renal diseases.

Brown or green urine: due to presence of bile.

Pale urine: in chlorosis, anæmia, diabetes, atonic gout, hysteria.

High-colored: in (i.) organic disease of the liver, (ii.) febrile states or inflammations.

"Milky": due to deposits of phosphates or white urates. See also White Urine.

Influence of Drugs on Color of Urine:

Carbolic acid, externally or internally, darkens the urine.

Sulphuric acid, creosote, arseniuretted hydrogen cause black tint.

Inunction of tar causes black tint.

Gallic and tannic acids cause dusky hue.

Strong coffee darkens the urine.

Indigo: greenish blue.

Aloes: deep red.

Madder, campeachy wood, mulberries: red.

Alizarin: rose-colored.

Gamboge, senna, logwood, picrotoxin: yellow.

Santonin: rich golden yellow in acid urine; orange red in alkaline.

Rhubarb: deep gamboge yellow changed to red on addition of ammonia.

Resin: grayish yellow.

In regard to the dark color of the urine, caused by carbolic acid poisoning, Reichert says that in 56 such cases he found 20 per cent were colored dark; this color may appear in two hours or so, and last several days and at times is only perceived by holding the urine to the light. According to Kirmisson, if the urine have a dark or a dark green hue, care should be taken about continuing the use of the acid. In chlorate of potassium poisoning the urine may be colored black.

In a case of poisoning by duboisin, recorded by Berner, the urine was as colorless as water.

In a case of poisoning from the external use of carbolic acid, reported by Weiss, the urine first became dark colored, but subsequently lost this coloration and became chylous.

In two cases of poisoning from the external use of aniline chlorhydrate for psoriasis, the urine was colored *dark red.* (Lailler.)

In a case of poisoning from the external use of pyrogallic acid, the urine became dark brown. (Neisser.)

The urine of a patient suffering from a *burn* may be brownish green, from presence of bile pigments.

In cases of chronic lead-poisoning the urine, after anæmia or icterus has set in, may become brown from presence of blood pigment; subsequently, abundant and clear. (Gautier.)

According to Robin (Essai d' Urolgie Clinique) there are three varieties of *blue* urine:

I. Urine blue at time of emission.

II. Urine becoming blue after standing several hours.

III. Urine containing blue layers.

The first variety, that blue at time of emission, is very rare, and only two cases have come under his observation.

He has seen eight cases of the second variety, in typhoid fever, and deems blue urine in this disease a favorable sign.

In chronic affections of the spinal cord he has seen two cases of the third variety.

Transparence.—We have learned that normal urine should be clear with the merest cloud of mucus, etc., settling to the bottom on standing.

If the urine is clouded within eight to ten hours after it is passed or at the time it is passed, it contains those substances which after long standing form a sediment, (see Sediments) and is pathological.

We caution physicians against inferring that, because the urine is transparent, it is necessarily normal; but, on the other hand, distinct turbidity always allows us to conclude that there is some abnormal condition. Urine may be perfectly clear when first passed, but on cooling throw down a sediment of urates, especially in cold weather. Opaque urine which on heating and application of acids becomes turbid may contain albumin or pus.

Urine turbid when *first passed* often contains *pus*. A whitish sediment in urine may be phosphates or possibly

urates; heat clears urates; a drop or two of nitric acid clears phosphates, the urine after such treatment appearing normal.

Consistence.— Hippocrates said that "bubbles maintained upon the top of the urine signify a disease of the reins and, likewise, its long continuance," a fact which Dr. Southey, in his Lumleian Lectures on Bright's Disease, remarks, remained unimportant until the end of the last century, when it was ascertained that albuminous urine held a froth of bubbles on its surface.

Hassall, in reviewing these statements affirms that the persistent presence of air-bubbbles on the surface of urine may be noted in most cases of albuminuria, but that it does not follow that all urine which froths is albuminous; he thinks the frothing in some cases to be connected with the high density of the urine; in others, with its feeble acidity or alkalinity; in others, with an excess of mucus.

In general, the occurrence of retained and persistent air bubbles on the surface of urine is nearly always of pathological significance. Kirk thinks that fatty or oily matter in the urine prevents the formation of bubbles.

Pathologically, we find the urine viscid, when containing pus in large amount.

Urine containing bile foams easily and profusely.

In urine containing sugar or albumin, any foam which may gather will remain longer than in the case of healthy urine.

When the urine has become strongly alkaline and contains at the same time *pus*, it will often become so stringy and tenacious as not to drop from the tube or vessel.

Chylous urine (urine containing chyle) is often jelly-like in consistency.

In certain cases of fibrinuria (urine containing fibrin)

the urine soon after being passed coagulates in the vessel.

King mentions having seen several specimens of urine white in color and of creamy consistence forming a thick jelly-like mass shortly after being voided; he found in such urine no fat of any kind, but an incredible amount of mucus and phosphates.

Odor.—If the odor of urine be ammoniacal and repulsive it may be merely stale, hence ascertain how long it has stood; urine on standing, especially in summer, or in a warm room, will become alkaline in time, if exposed to the air, and take on a disgusting odor. If this offensive odor is noticeable soon after the urine is passed into a clean vessel, then the urine is pathological, indicating decomposition of it within the body.

Such putrid, offensive urine of an alkaline reaction is found in affections of the brain and cord and in certain genito-urinary diseases, especially in advanced cases of severe cystitis, or destructive renal diseases; in certain renal diseases the odor is often gangrenous.

Fresh diabetic urine smells sweetish; *stale*, like sour milk; purulent and sanious discharges in the urine cause a stale, offensive odor like that of tainted flesh.

Certain articles of diet, as asparagus, cauliflower, garlic, onions, and certain drugs, as turpentine, valerian, asafœtida, castor oil, copaiva, cubebs, sandal-wood oil, communicate certain peculiar odors to the urine.

Reaction.—The normal reaction of the urine is known to be slightly acid, i. e., turns blue litmus slightly red; on standing some time "acid fermentation," so-called, sets in and the urine becomes strongly acid, i. e., turns blue litmus paper bright red, then subsequently becomes strongly alkaline, after the so-called "alkaline fermentation" sets in.

Before the physician decide upon the clinical significance of the reaction of the urine he must ascertain how long the urine has been standing, and if over twenty-four hours its reaction is not always a reliable guide.

Two conditions of the urine are of clinical significance:

I. Strong acidity, when freshly passed.

II. Alkalinity within twenty-four hours.

Diseases in which the Freshly Voided Urine is Strongly Acid:

I. Fevers, inflammations, especially liver, heart, lungs.

II. The urine may be strongly acid and yet no acute febrile disturbance be present; in this case the formation of sediments and concretions is to be feared, especially of uric acid.

It is difficult to increase sensibly the acidity of urine by administering acids; but if it is desirable that the urine be kept steadily alkaline 300 or 400 grains daily of bicarbonate of soda or potash, or of the acetate or citrate of either of these bases, will bring about the desired results.

Diseases in which the Urine may become Alkaline within twenty-four hours.

I. Debility, exhaustion from over-work, care, anxiety, etc.

II. Anæmic states following subacute rheumatism and gout.

III. Chlorosis.

IV. Functional derangements of the liver with diminished acretion of bile; dyspepsia, chronic vomiting.

V. Many acute diseases, as typhus, scarlet fever, enteric troubles, pneumonia, and convalescence from same.

VI. Pulmonary complaints, as in phthisis; long continued respiration of impure air.

[The alkalinity in the cases (I.–VI.) is due to

presence of *fixed* alkali so-called, i. e., potash or soda not ammonia; such urine shows no tendency to contain gravel or calculi and is not associated with inflammation of the urinary passages].

VII. Local affections of mucous membrane of lower urinary passages: (i.) Bladder troubles as paraplegia with paralysis of bladder, morbid growths, calculous concretions, cystitis; (ii.) obstinate urethral stricture, enlarged prostate.

Conditions which interfere with the complete emptying of the bladder render the urine alkaline from development of ammonium carbonate into which urea is changed (by the presence of a "ferment" called by Béchamp, nephrozymase), when for any cause the urine either wholly or in part is retained in the bladder.

Urine which is alkaline when first passed, or very soon thereafter, from ammonia is irritating to the mucous membrane and leads to cystitis. Such urine *always* contains a sediment of phosphates (amorphous lime-phosphate and ammonio-magnesium, or triple phosphate, together with spheres and dumb-bells of ammonium urate which tend to gather together into masses). It is ammoniacal, often putrescent in odor.

It is important that the physician be able to distinguish between urine alkaline from presence of a fixed alkali and urine alkaline from presence of ammonia.

Urine alkaline from fixed alkali.

I. Bland and innocuous to the mucous membranes.

II. No inflammation of urinary passages.

III. Pleasant, often aromatic odor.

IV. Seldom contains sediment; if any, amorphous phosphate of lime.

V. Turns red litmus paper *permanent* blue.

Urine alkaline from ammonia.

I. Irritating to the mucous membranes.

II. Inflammation of urinary passages.

III. Ammoniacal or offensively putrescent odor.

IV. Contains abundant deposits, phosphates (amorphous and triple).

V. Turns red litmus paper blue which fades to red again on exposure for a short time to air.

Cautions.—Before deciding that the urine is alkaline from ammonia be sure, (i.) that it is alkaline when first passed, (ii.) that the vessel containing it was *perfectly clean.* Always remember (i.) that stale urine which has been exposed to the air becomes, in time, ammoniacal, (ii.) that if a vessel contain a little stale urine fresh urine passed into it *rapidly* becomes ammoniacal. The physician must see that the chamber vessels and urine glasses of the patient are not merely emptied but thoroughly washed so that every trace of the stale urine is removed.

Agents which exert an influence on various conditions of the urine.

I. Solid matters in the urine are increased by appreciable doses of digitalis, belladonna, colchicum, carbonate of potassa, white Rhine-wine and many other agents. Masterman has shown (*Lancet*, October, 1880,) that *beef tea* is analogous in its chemical analysis to urine except that it contains less urea and uric acid.

II. The solids are decreased in the urine by citrate of quinia and iron, ammonio-citrate of iron with quassia, alcohol, beer, coca, tea, coffee, and Paraguay tea; also by opium, morphia, conium, calabar-bean, hyoscyamus, cannabis. It is necessary to exercise some care in decreasing the solids in the urine by use of the last named drugs owing to their action on the nervous system.

III. The fluids of the urine are increased by sweet spirits of nitre, beer, gin, turpentine, whisky, coffee without sugar or milk, large draughts of soft water, and by other agents called *diuretics.*

IV. The fluids are diminished by conia, citrate of quinia and iron; iron, copper, and ammonio-citrate of iron with quassia; arsenic and cantharides in appreciable doses may almost wholly arrest the flow of urine.

NORMAL CONSTITUENTS.

UREA $(NH_2)_2CO$.

Urea is a substance composed of one part carbon, four parts hydrogen, two parts nitrogen, and one part oxygen—by weight; its most important constituent from a clinical point of view is *nitrogen*, since five-sixths of all the nitrogen absorbed in the food passes out of the body as a component part of this chief constituent of normal urine. Pure urea is white, semi-transparent, and crystalline (four-sided or circular crystals), odorless, of a bitter, cooling taste, somewhat like that of nitre. Urea is very soluble in water and is therefore never seen in the urine; to obtain it in the pure state described above, various chemical processes are required.

The amount of urea present in urine is indicative to a certain extent, of the wear and tear of the system—taking into careful consideration circumstances of diet, habit, etc. The normal amount of urea passed in twenty-four hours is from 25 to 40 grammes (385 to 600 grains).

According to Brouardel, the quantity of urea depends upon the integrity of the hepatic cells and the greater or less activity of the hepatic circulation.

Tables of Harley:

Normal urine of twenty-four hours:

Boy, 18 months,	8–12 grammes,	-	124.0–186.0 grains.
Girl, "	6– 9 "	-	93.0–139.5 "
Man, 27 years,	25–35 "	-	387.5–542.5 "
Woman "	20–30 "	-	310.0–465.0 "

Proportion of urea according to weight:

Boy,	0.4 gramme,	- - -	6.2 grains to the pound.	
Girl,	0.35 "	- - -	5.4 "	" "
Man,	0.25 "	- - -	3.8 "	" "
Woman,	0.20 "	- - -	3.1 "	" "

These tables show that children, relatively, excrete more urea than adults, and that men excrete absolutely and relatively, more than women. The "average man" then excretes about 3.8 grains of urea to the pound of weight—the average woman, 3.1.

Purely animal diet will increase the daily amount of urea to from sixty to ninety grammes; purely non-nitrogenous diet will reduce it to less than fifteen. Hence in diseases where there is excess of urea animal diet is strongly contraindicated; in diseases where it is deemed advisable to increase it, animal diet is indicated.

Diet which may increace the amount of Urea:

I. Animal food, especially lean meat; animal soups.

II. White of egg, milk, jellies, coffee without sugar.

Diet which may decrease the amount of Urea.

I. Amylaceous foods: tapioca, arrow root, sago.

II. Sugar.

III. Oleaginous foods: Cream, cod-liver oil, etc.

The latter diet is indicated when there is excess of urea in the urine; if the patient crave meat give him meat fat.

Vegetables may be allowed when it is desired to decrease

the amount of urea; a purely vegetable diet will diminish it one-third.

A careful distinction must be drawn between a diminished *excretion* of urea and a diminished *formation* of it; in some diseases urea although formed in the body is held back and does not appear in normal amount in the urine, in others it is scantily formed in the body. When the condition called *uræmia* is present there is but little urea to be found in the urine, yet it would not be advisable to put the patient on an animal diet since such urea as is formed is not readily excreted. When formed by the system, and through any interruption of the eliminating function of the kidney, accumulated in the blood, it is called by some authors, "a powerful irritant poison, rapidly inducing convulsions, coma and death."

Substances which increase urea in the urine.—Water, common salt, atropin, cubebs, cantharides (in appreciable doses). Copious draughts of water aid in the elimination of urea.

Substances which decrease urea in the urine.—Digitalis, benzoic acid, acetate of soda, phosphate of soda, colchicum, tonics, especially citrate of iron and quinine.

Clinical significance of urea.—The diseases in which urea is *increased* in the urine are:

I. Acute febrile states with emaciation (except yellow fever).

II. Exanthemata.

III. Inflammatory affections.

IV. Some nervous diseases.

V. Diabetes insipidus and mellitus.

VI. Atrophy from dyspepsia (in children).—Athrepsy, Parrot and Robin.

VII. Diffuse bronchial catarrh (without fever).

VIII. Phosphorus poisoning.

The increase of urea in acute febrile disorders, as typhoid fever, continues up to the acme of the attack, reaching anywhere from 50 to 80 grammes for the twenty-four hours; when the fever diminishes there is less metamorphosis of tissue, less "wear and tear," less urea. During convalescence the amount gradually returns to normal.

The above mentioned course is the general rule in the majority of instances; individual exceptions are sometimes noticed.

In intermittents the increase in urea begins *before* the chill; in other words, the *increase in urea shows the coming of the paroxysm before the clinical thermometer can detect any rise in temperature.*

In typhoid fever we find urea enormously increased; Harley cites a case where 78 grammes (1209 grains) were passed in twenty-four hours.

Vogel found the amount in this disease at the height to fluctuate between 40 and 55 grammes (617 to 847 grains); as the fever diminished it fell to 20 grammes (308 grains) to rise to normal with convalescence.

We find urea increased in typhus, remittent fevers and exanthematous diseases, but not generally to such an extent as in typhoid fever.

In inflammations, as well as in fevers, the amount is increased. A case of croupous pneumonia is cited where the amount of urea on one day reached 80 grammes (1240 grains).

In pneumonia, daily averages of from 40 to 60 grammes (617–925 grains) and even 70 grammes (1080 grains) are found.

The practitioner will do well to remember that urea is derived from the breaking up of the nitrogenous tissues of the body; that during the height of acute diseases this breaking up is abnormally increased, hence the amount of urea is abnormally increased in the urine.

It stands to reason, then, that in such diseases knowledge of the fact that urea is diminishing is, as a general rule, knowledge of the fact that the disease is abating.

After the height of an acute malady has been reached the amount of urea will often fall below normal, to rise again as convalescence ensues.

When, previous to an acute malady, there has been a state of impaired nutrition, or, in a fever when there has been much sweating, we must not expect to find remarkable increase of urea.

In pyæmia the amount of urea is greatly increased; 80 grammes (1234 grains) a day have been known.

In many nervous diseases we find the daily amount of urea increased, among which epilepsy—especially during and after the attack—chorea, and progressive muscular atrophy.

In diabetes mellitus 70 grammes (1080 grains) in twenty-four hours have been found, and in insipidus 84 grammes (1296 grains).

Diseases in which Urea is Decreased in the Urine.

I. Long-continued organic diseases.

II. Chlorosis.

III. Paralysis.

IV. Cholera.

V. Yellow fever.

VI. Ovarian tumor and uterine cancer.

VII. Before paroxysms of gout and of asthma.

We find urea *decreased* in amount in the urine of per-

sons suffering from those chronic complaints "which are accompanied by diminution of the tissue metamorphosis or of the nutrition. During intercurrent exacerbations, hectic fever, etc., it is increased again."

A distinction must be made between decrease in urea due to decreased tissue metamorphosis and that due to inability on the part of the body to get rid of it when formed.

We find urea retained in the body in dropsy and in the condition known as uræmia.

In yellow fever the uræmic condition is found and amazingly small amounts of urea may be voided.

When the kidneys are disordered urea is decreased, thus we find in Bright's disease a deficiency of this substance in the urine.

We find urea decreased, also, in paralysis, anæmia, chlorosis, ovarian tumor and uterine cancer (Thudichum), Addison's disease. (Rosenberg.)

In acute yellow atrophy of the liver, the substances known as leucin and tyrosin replace urea in the urine and but little of this last substance is found.

In cholera, urea seems not to be formed in the body. (Beale.)

The inferences to be drawn from the variations of urea are as follows: The urine of twenty-four hours having been examined, if the acme of a disease from *other* indications seems to have passed and the amount of urea be still largely in excess, the prognosis is unfavorable; if, however, the amount of urea decreases from day to day the prognosis is favorable.

In Bright's disease, if the amount of urea remains about normal a more favorable condition is indicated than if the amount be decreased. In any disease, as

cholera, where a *diminished* amount of urea has been found, a gradual or rapid increase is a favorable sign.

If for a long time much less urea than normal is passed with the urine, we may have reason to fear that uræmia may result from the retention of urea in the blood. (Vogel.)

If, in dropsy, diuretics have been given, or for any other reason the kidneys manifest increased activity, the amount of urea will be largely in excess.

The physician must carefully bear in mind the fact that in *strongly ammoniacal* urine part of the urea has been converted into carbonate of ammonium, hence the amount of urea found in such urine "is no criterion of the amount of urea produced."

Estimation of Urea.—Hypobromite Process.—One of the best methods of estimating urea by the use of hypobromite, is that of Yvon, which is a modification of the Knop-Hueffner method; with the necessary apparatus the analysis can be made in five or six minutes at the patient's bedside. The apparatus consists of a long, wide, bell-mouthed beaker and a glass tube called an ureometer, 40 centimetres long and 1 centimetre in diameter. The ureometer is divided into two compartments by a glass stop-cock placed toward its upper quarter, which allows a communication between the two compartments to be established or suppressed at will. Commencing at this stop-cock, the tube is graduated, above and below it, into cubic centimetres and tenths of the same. The lower part of the tube is the longest, from its extremity to the stop-cock, and is designed to be placed into a mercury jar, as hereafter described. The *standard* solution employed consists of solution of caustic soda, (36°), 30 grammes, dissolved in distilled water, 125 grammes, to

which add, when cold, bromine, 5 grammes, and agitate strongly. Allow it to rest for some time, and, after decantation, a fine yellow, clear, transparent fluid remains which has to be frequently renewed, as it loses considerable of its strength in a very short time. By keeping the solution of caustic soda, separately, this preparation may be made in small quantity, whenever required, by adding to any given amount of it the proper proportion of bromine. As a *test liquor* of this standard solution, 1 gramme of pulverized urea, well dried by a prolonged sojourn under a bell glass with sulphuric acid, is dissolved in distilled water so as to have 5 cubic centimetres of the solution equal to 1 centigramme of urea. After the action of the standard solution of hypobromite of soda, upon this solution of urea, 37 divisions of the tube or $\frac{37}{10}$ of a cubic centimetre of gas will correspond to one centigramme of urea. Ten cubic centimetres of the non-albuminous urine are diluted with distilled water to make a volume of 50 cubic centimetres, and of this diluted urine from 1 to 5 cubic centimetres are operated upon, according to its richness in urea. Polyuric urine requires no dilution. We must always endeavor to have no more than forty divisions of gas, in order not to increase too greatly the volume of the standard solution to be employed, and the dimensions of the column of liquid. The method of proceeding is as follows: Open the stop-cock and plunge the inferior extremity into the jar filled with pure mercury, until this has arisen to a level with the lower part of the superior compartment; then close the stop-cock, raise the tube (but not entirely out of the mercury,) the inferior compartment of which is filled with the mercury, and maintain it in this position by means of a strap or collar, which forms part of the com-

plete apparatus. Into the upper apartment place from 1 to 5 cubic centimetres of the diluted urine, open the stop-cock, and carefully make the fluid flow into the inferior compartment, closing the stop-cock before any air can pass along with it. Wash the receptacle at the superior part of the tube with several drops of distilled water, and carefully pass this into the lower apartment, by means of the stop-cock, as in the previous instance. This done, place in the upper receptacle five or six cubic centimetres of the standard solution, and, as in the first instance, make it pass into the lower apartment, raising the tube a little should this be necessary. Agitate by an up-and-down motion, but without removing the tube entirely out of the mercury, having the stop-cock closed, of course. Decomposition occurs immediately, the urea is separated into water, nitrogen, and carbonic acid gas; the last being absorbed by the excess of alkali, nitrogen alone remains in the tube. To render the mixture more exact, raise the tube, close the lower orifice, while this is under the mercury, with a finger, and shake it; then carefully replace it in the mercury. The liquid soon becomes limpid when all the gas has collected together, and the amount of gas may be read off on the graduated divisions at the level of the fluid remaining in the lower compartment. The measurement of the gas is made in a beaker filled with water, being careful properly to place the surface of the liquid in the tube on a level with that of the fluid in the beaker. For instance, 5 cubic centimetres of the diluted urine have been operated upon, and we find 22 divisions of gas produced, and as 5 cubic centimetres of the standard solution represents 1 centigramme of urea, we have $\frac{2}{3}\frac{2}{7}$ of a centigramme of urea. But the urine has been diluted to five times its volume with water,

from which we can readily conclude that 1 cubic centimetre of the original undiluted urine contains $\frac{22}{37}$ of a centigramme of urea. If 800 cubic centimetres of the urine are passed in twenty-four hours we have $800 \times 22 \div 37 = 4.754$ grammes of urea in 800 cubic centimetres of urine; or 5.945 grammes of urea in 1000 cubic centimetres of urine.

SODIUM CHLORIDE.

(Common Salt.)

Common salt is a normal constituent of urine, its chemical name being sodium chloride and symbol NaCl, one part sodium and one part chlorine.

According to Vogel the healthy adult passes 10 to 13 grammes *per diem* (154 to 200 grains).

Salt is soluble, therefore never seen in the urine.

The *excretion* of salt depends chiefly upon the activity of the kidneys; the salt excreted comes in the main from salt ingested in food, although if no food be taken, a small amount of salt will be excreted.

Salt is increased in the urine, then, by food in general, especially that containing salt and by copious draughts of water which dissolves it and aids in its elimination; salt is decreased in the urine by lack of food and of water.

A great decrease or an entire absence of salt is of interest to the physician.

Diseases in which Salt is Decreased or Absent.

I. Acute diseases; especially inflammation with exudation.

II. Cholera.

In inflammations attended by exudation salt may be

absent from the urine; for example, in pneumonia when the lung becomes hepatized, salt may be absent for two or three days; resolution occurring it reappears. When absent from the urine, salt may be found in the sputa. (Beale.) Salt has a tendency to centre around a point where inflammatory changes are taking place, hence diminished in the urine. (Beale.)

In acute articular rheumatism, sudden *absence* of chloride with *appearance* of albumin, may indicate a coming attack of pericarditis.

In cholera, salt is greatly diminished; "an increase in salt in the urine during an attack of cholera is a most reliable symptom of recovery." (Buhl.)

In inflammatory diseases and in cholera the physician may obtain aid in making a prognosis by testing the urine for salt; if absent or greatly diminished for any length of time it is an unfavorable sign.

Diseases in which Salt is Increased in the Urine.

I. Intermittents, during the *chill* and *fever* (twenty-four hours amount *normal*).

II. Progressive muscular atrophy. (Bamberger.)

The following summary of Vogel is of interest:

"In all acute diseases a *progressive diminution* of salt shows an *increase,* and a *progressive increase* of salt a *diminution* of the disease; if the amount fall below 0.8 gramme daily we conclude that there is considerable intensity of the disease."

In chronic diseases the amount of salt is a tolerably accurate measure of the digestive power of the patient; an abundant amount (10 to 16 grammes daily) permits us to infer that digestion is good; a small amount (below 8 grammes) shows a weak digestion, provided there are no watery dejections or any other moderate exudation.

SULPHURIC ACID.

In Combination Forming Sulphates.

Normal urine contains sulphuric acid, in daily amount averaging from 1½ to 2½ grammes, and in combination with sodium and potassium* forming the sulphates of the latter. The ingestion of sulphur, sulphides, or sulphates contained in articles of diet will increase the amount of sulphates in the urine but under no circumstances is there ever a deposit of them. The clinical significance, if any, of the sulphates is but imperfectly understood; if their amount increase in *acute febrile* disorders when *little or no food is taken* decomposition of the elements of the body is indicated.

The sulphates are *increased* in:

(i.) Progressive muscular atrophy. (Bamberger.)

(ii.) Phosphorus-poisoning. (Cazeneuve.)

(iii.) Diseases of the brain. (Bence Jones.)

The sulphates are *decreased* in:

(i.) Chronic renal disease. (Heller.)

(ii.) Carbolic acid poisoning. (Baumann.)

The author has observed one case of Bright's disease, (chronic form) in which no sulphates could be detected by the ordinary methods; examining the urine of a patient who had had a considerable number of hypodermic injections of phenic (carbolic) acid, (Déclat method) he found the sulphates about normal in amount.

PHOSPHORIC ACID.

In Combination Forming Phosphates.

The amount of phosphoric acid, which in combination with potassium, sodium, calcium and magnesium, is passed

* Strictly speaking, with the oxides.

daily in the urine averages from 2.5 grammes to 3 grammes daily (38 to 46 grains). Two-thirds of this amount is contained in the phosphates of sodium and potassium (alkaline phosphates), and the remainder in the earthy phosphates, i. e., those of calcium and magnesium.

It has been customary to attach considerable importance to a deposit of earthy phosphates—which will occur when the urine becomes alkaline, (see Deposits)—whereas from the very reason that deposits of these substances depend upon an alkaline condition of the urine they rarely have a grave import, except when composed of the triple phosphate.

Persistent excessive elimination of phosphoric acid with or without deposition of the earthy phosphates, is generally associated with grave constitutional disturbances. (Ralfe.)

Diet which may Increase the Amount of Phosphates in the Urine:

Beef, bread, potatoes, milk.

Diet which may Decrease the Amount of Phosphates:

Starchy, saccharine, and oleaginous foods.

Diseases in which the Total Amount of Phosphates may be Increased:

I. Inflammatory diseases of the nervous system; nerve lesions in general—injuries to the head.

II. Acute febrile disorders (not invariably).

III. Bright's disease and cholera (if obstruction be removed by which they have been retained).

IV. Phosphorus-poisoning.

[In rachitis, according to Seeman, phosphates actually *diminished* in the urine.]

Diseases in which the Total Amount of Phosphates may be Decreased:

I. Renal and intestinal diseases. (Brattler.)

II. Intermittent fever, during the interval. (Haxthausen.)

III. Chronic diseases of the brain, exhaustion stage of mania, acute dementia, delirium tremens.

IV. Severe pneumonia.

V. Gout and arthritis deformans.

(An increase in the amount of phosphates in *these* diseases is therefore favorable.)

Diseases in which the Earthy Phosphates may be especially Increased in the Urine:

I. Mollities ossium.

II. After severe burns.

III. Nervous exhaustion from severe study and loss of sleep.

IV. Diabetes.

V. Tertiary syphilis.

VI. Cerebral and spinal tumors; osseous tumors.

VII. Cancer.

VIII. Caries.

IX. Meningitis.

X. Progressive muscular atrophy, (magnesium phosphate chiefly.)

The physician must carefully bear in mind the fact that when urine is *acid* in reaction, it may contain an excessive amount of phosphates and yet contain no deposit; nor is a deposit of them necessarily a sign of excessive amount, since *alkalinity* of the urine will cause them to appear even when not in excessive amount.

When we have to deal with the persistent elimination of phosphoric acid in excessive quantities very distressing

constitutional symptoms are asoociated with its discharge. The symptoms vary considerably in individual cases, but they are all more or less characterized by great nervous irritability, derangements of digestion, great emaciation, severe aching pains in the back and loins, especially affecting the pelvic viscera. (Ralfe.) When these symptoms are present and the urine is copious, of acid reaction and clear, an estimation of the quantity of phosphoric acid may throw new light on an otherwise doubtful case.

When it is remembered that persistent elimination of phosphoric acid is sometimes a forerunner of diabetes, especially insipidus, the importance of an early recognition of the condition may well be comprehended. Increased amount of phosphates in the urine is often associated with troublesome eye affections; it is also found in connection with tardy reparation of wounds and is apt to render bones more fragile, causing fractures and tardy union. The physician, therefore, should not plume himself on the fact that as the urine is clear and free from deposit it is therefore clinically meaningless, until he has proved that the phosphates are not persistently in great excess. When the urine is *alkaline* and "whey colored" from a heavy deposit, the attention of both patient and practitioner will naturally be called to it. See Deposits.

URIC ACID.

In Combination Forming Urates.

Uric acid in combination with sodium, potassium, ammonium, or (rarely) calcium, forming the urates of sodium, potassium, etc., is a normal constituent of urine. About $1\frac{3}{4}$ grammes of urates (27 grains) are voided daily.

Diet which may Increase the Amount of Urates:

Nitrogenous foods: lean meat, etc. Port wine, beer.

In other words, "high living" is often responsible for an increased amount of these substances.

If the urine is not too acid in reaction it may carry an increased amount of urates without showing a deposit of them; in such cases the specific gravity will be comparatively high, 1020 or 1025. To estimate the amount of uric acid passed daily in combination with its bases is not at all convenient for the physician. For further consideration see Deposits.

Increase but not Necessarily Deposit of Urates in Disease.

The advice of Coignard in regard to uric acid in the urine is worth remembering: "In a large number of persons no actual disease can be demonstrated but they are constantly ailing, are more irritable than their fellows, especially if their hygienic surroundings are bad, their life idle or their occupations sedentary. In such cases it is necessary to estimate the amount of uric acid combined and forming urates, and if there be excess, correct the diet, give them plenty of exercise and a methodical alkaline treatment."

According to Ralfe, uric acid is eliminated in excess, (i. e., in combination with urates) but not necessarily deposited from the urine under two conditions:

1. Uric acid in excess usually attended by a diminution of the other urinary constituents, (true lithæmia); this occurs chiefly in diseases of the liver, such as acute yellow atrophy, cirrhosis, and cancer. In scurvy an excess of uric acid is generally observed with a diminution of urea and the alkaline phosphates.

2. Uric acid in excess attended by an increase of the

other urinary constituents; this may occur in functional derangements of the liver, especially those brought about by disturbance of the "nitrogenous equilibrium," by the ingestion of too much animal food. It may happen as a condition antecedent to the development of phthisis or cancer and sometimes of diabetes, or preceding the outbreak of such constitutional conditions as syphilis, scrofula, and of gout in its early attacks.

In order to ascertain whether uric acid is in excess its amount must be estimated, i. e., the total amount combined with sodium, potassium, etc., forming the urates.

Dr. E. A. Cook (*British Med. Journal*, April 15, 1882,) gives a method for approximately estimating the amount of uric acid in normal urine and the results of his process go to show that the normal amount of uric acid excreted by a healthy adult is much greater than has hitherto been supposed; not less than ten grains and seldom less than twelve grains being the quantity discharged in twenty-four hours. His method is the following: Take 300 or 400 cubic centimetres of the urine and add a few drops of strong solution of caustic soda, enough to render it decidedly alkaline; allow the precipitate of phosphates to subside and pour off 100 cubic centimetres of the clear solution; add to this clear solution about 4 cubic centimetres of a solution of zinc sulphate, 1 to 3 strength. The solution of zinc sulphate renders blue litmus red and it must be added to the urine until a drop of the mixture on blue litmus gives a slightly red circle. If the solution be too acid, a drop or two of caustic solution will render it neutral. The precipitate is thrown on a filter, and washed with a saturated solution of zinc urate. This solution is made by adding a little zinc sulphate to distilled water, and then adding urate of soda until

a permanent precipitate remains; this precipitate is allowed to subside, and the solution is used for washing until all urea and ammonia are removed. The drained precipitate is folded in the filter and placed with 50 cubic centimetres of hypobromite of sodium of full strength in an urea estimation apparatus, and agitated carefully. The gas evolved will be an indication of the amount of uric acid present in 100 cubic centimetres of the urine, inasmuch as 8 cubic centimetres of nitrogen gas at 60° F., and 30 in barometer are evolved from 10 cubic centimetres of a solution of sodium urate, (containing 648 grammes of uric acid in 100 cubic centimetres) plus 90 cubic centimetres of water. The reaction is complete at the end of half an hour without the application of heat.

The practitioner will guard against confusion in the use of the terms "uric acid" and "urates" by remembering that urates are a combination of uric acid with sodium, etc., and it is customary to estimate the amount of this uric acid, which is in combination, and to speak often of urine containing so much "uric acid," meaning simply the amount of uric acid in combination with the sodium, etc., forming urates. *Uncombined* uric acid is normally present only in very small amount; when plenteous it forms a sediment.

COLORING MATTERS.

Determination of Urinary Coloring Matter.—Vogel's table of colors gives results sufficiently accurate for clinical purposes; filter the urine, pour it into a glass jar of not less than 4 or 5 inches diameter and observe what color in Vogel's scale it nearest corresponds to. (Books of colored papers representing the colors of Vogel's scale

can be had of dealers in chemical apparatus and of many surgical instrument makers.)

After having ascertained the color of the urine consult the following table:

I	II	III	IV	V	VI	VII	VIII	IX	
1	2	4	8	16	32	64	128	256	Pale Yellow = I
	1	2	4	8	16	32	64	128	Light " = II
		1	2	4	8	16	32	64	Yellow = III
			1	2	4	8	16	32	R'ddish " = IV
				1	2	4	8	16	Yell'ish Red = V
					1	2	4	8	Red = VI
						1	2	4	Brownish " = VII
							1	2	R'd'sh Br'wn = VIII
								1	Brownish Bl'k = IX

Form a proportion as follows:

1000 : the number corresponding to the color of the urine :: the quantity for 24 hours : x.

If the urine is yellow look under III and we find the first figure to be 4; therefore 1000 : 4 :: quantity for 24 hours : x. Suppose in 24 hours 1800 cubic centimetres of urine were passed, then 1000 : 4:: 1800 : x, or x = 7.2 parts coloring matter in 1800 cubic centimetres yellow urine.

CREATININ AND HIPPURIC ACID.

The urine of twenty-four hours normally contains 5 or 10 grains of creatinin; it is of no clinical significance.

Hippuric acid is increased by the eating of much fruit, especially prunes, mulberries and bilberries, and by the ingestion of the balsams of Peru and tolu and benzoic acid. The microscopical appearance of hippuric acid crystals may lead one to possible confusion with those of triple phosphate. Hippuric acid, however, rarely, if ever,

deposits itself in the urine *spontaneously*; a drop of hydrochloric acid has no effect on its crystals, but dissolves the triple phosphates. The normal amount of hippuric acid is 0.5 to 1.0 grammes (7 to 15 grains) in twenty-four hours.

ABNORMAL CONSTITUENTS OF URINE.

Albumin. — The term "abnormal constituent," with reference to albumin, is here used notwithstanding the observations of many who have found a small amount of albumin in the urine of healthy individuals. For instance, Senator, of Berlin, examining the urine of himself and three colleagues, found traces of albumin occurring every now and then at different times in the day. Frerichs, J. Vogel, Ultzmann, De Mussy, Leube, Gull, Edlefson, Marcacci, Munn, Bull, Fuerbringer, and others, have recorded cases of a similar nature. The routine practitioner is not apt to be greatly puzzled by finding albumin for which he can not account, since the so-called "normal albumin" occurs in very small amount and is not likely to be noticed by one making a hurried test and having little experience in chemical manipulations. Any one interested in the subject will find its literature given by Dr. Ellis, of Harvard Medical College, in the *Boston Medical and Surgical Journal*, as well as an interesting paper and discussion in the report of the stated meeting of the New York Academy of Medicine for Dec. 15, 1881, and a long chapter in Senator's new monograph, Die Albuminurie.

Transitory albuminuria has been noticed in the urine after injury to the skull. (Peabody.) After the drink-

ing of a pint of milk. (Smith.) After external applications of iodine. (Bouchut.) After inhalations of turpentine. (Emerson.) After persistent albuminous diet. After excessive smoking of cigarettes. (Bradley.) After poisoning by oxalic acid. (Silk.) After inunction with Goa powder ointment. (Israel.) After use of iodoform dressings. (Zeissl.)*

Diseases, etc., not Bright's, in which Albumin may be Found in the Urine.

I. Diseases in which notable diminution of oxidation follows a difficult respiration: croup, laryngeal diphtheria, ascites, emphysema with much dyspnœa, pulmonary phthisis (especially if complicated with pneumonia and there is great difficulty of respiration), pregnancy and the puerperal state.

II. Cyanosis: heart troubles, where there is partial asphyxia.

III. Eclampsia.

IV. Cholera.

V. Idiopathic or traumatic lesion of nerve centres, with lowering of temperature and notable diminution of combustion.

VI. Diabetes.

VII. Curvature of the spine.

VIII. Natural or artificial suppression of cutaneous perspiration: measles, scarlet fever, small-pox; also after intense cooling of surface of body, as in a cold bath.

IX. Septicæmia, hospital gangrene, phlegmonous erysipelas, yellow fever, typhoid fever, typhus.

X. Miliary sweat, jaundice, chlorosis.

XI. Gout, red gravel, rheumatism.

* According to Kocher, acute nephritis may follow the use of iodoform dressings.

XII. Cachexies: syphilis, cancer, malaria, scrofula.

XIII. Febrile and inflammatory diseases in general: zymotic diseases, peritonitis, traumatic fever, meningitis, etc.; inflammatory affections of the skin: anthrax, furuncle, erysipelas, burns.

XIV. Diseases due to hydræmic condition of blood with atony of tissues: purpura, scurvy, pyæmia, etc.

XV. Nervous prostration from grief.

XVI. Impediments to the circulation: abdominal tumors, cirrhosis, etc.

XVII. Temporarily, after excretion of irritating substances, as balsam copaiva, turpentine, cubebs; of concentrated, highly acid urine; of oxalate of lime and sharp crystals of uric acid.

XVIII. Temporarily, after various vascular contractions: convulsions, epileptic and intermittent fever paroxysms.

Drugs causing the Appearance of Albumin in the Urine:

I. Anæsthetics, among them chloral hydrate.

II. Many emetics and cathartics, especially *drastic* cathartics.

III. Potassium nitrate.

IV. Coffee (sometimes).

V. Fuchsin, especially *arsenical fuchsin.*

VI. Various metallic salts: the mercurials, soluble compounds of antimony and lead, some salts of silver, and of cadmium, uranium nitrate, salts of copper, the arsenicals, chloride of gold and platinum.

VII. Poisoning* from arsenuretted hydrogen, carbon protoxide and dioxide, phosphorus, iodine, potassium iodide, carbolic acid (sometimes.)

* Prof. Wood reports albumin and casts in urine of patient who ha been taking heavy doses of salicylic acid. (See page 137.)

The injection of water into the veins may produce albumin in the urine.

Albumin is more often found in the urine of those who live in high altitudes than in that of those who live in low countries.

The following points in regard to the appearance of albumin in the urine are of particular importance:

(i.) In diphtheria, albumin in the urine appears *early* in the disease, an occurrence which is deemed of diagnostic significance.

(ii.) If albumin occur in the urine of a pregnant woman, look for *casts* (with the microscope,) and other evidences of renal disease. Since puerperal eclampsia is often accompanied by parenchymatous nephritis, i. e., inflammation of the substances of the kidney—the mere presence of albumin *alone*, without other signs of kidney disease, is not necessarily alarming.

(iii.) If the urine contain leucorrhœal discharge or spermatic fluid, albumin may be found due to their presence and no kidney disease is *necessarily* present.

(iv.) A pale, dilute urine abundantly albuminous is more indicative of Bright's disease than a dense, high-colored urine with less albumin, which is more apt to be indicative of pyrexia or some impediment to the circulation of the blood.

(v.) If pus or blood be found in the urine, see next paragraph.

False Albuminuria.—When the urine contains pus or blood, a not large amount of albumin is likewise found; this is the albumin of the blood or of the pus since both of these substances contain it; to get an idea of about how much albumin belongs to pus, add to normal urine some pus from a suppurating wound and after allowing

the sediment to form, apply the usual albumin test. (See Part I.)

This condition is termed *false albuminuria* and is found in diseases of the excretory passages and bladder, as,

(i.) Cystitis.

(ii.) New growths in the bladder.

(iii.) Stone in the bladder.

(iv.) Prostatis and hypertrophy of prostate.

Again, there are diseases in which besides pus and blood, more albumin occurs in the urine than the pus and blood will account for; these are diseases of the kidney-pelvis—pyelitis in its various forms; hæmorrhage from the kidney may be accompanied by more albumin than the blood will account for.

Bright's Disease.—Albumin is found in the urine of the various Bright's diseases, accompanied generally by abundant casts, renal epithelium, and fatty cells, by the presence of which they can be differentiated from simple hyperæmia, febrile hyperæmia, renal stasis proper, and false albuminuria.

Vulpian has noticed that in Bright's diseases the albuminoids in the saliva are augmented.

In Bright's disease the albumin in the blood is diminished.

Summary.—Sir Henry Thompson makes the following observation in regard to albumin in the urine: "Whenever clear urine of acid reaction, free from blood, contains a notable amount of albumin, such albumin is usually of renal origin.

Professor Wood on Quantity of Urine in Bright's Disease:

An important aid in the diagnosis of the Bright's diseases, is knowledge of the daily amount of urine passed. "In only an exceedingly small percentage of the cases in

which I examine the urine I am able to learn, approximately, how much the patient is passing," says Prof. E. S. Wood, of the Harvard Medical School; "in private practice measurement of the urine, in cases of known or suspected renal disease or complication, is the rare exception. * * *

"It is no hardship to require actual measurement of the urine in case of patients who are not confined to the house, since they can be provided with a wide mouthed bottle fitted with a tight stopper and sufficiently large to contain the amount passed at a single micturition. This bottle can be graduated into twenty-five or fifty cubic centimetre spaces or into fluid ounces, by a file mark on the glass or by marks on a strip of paper pasted on the outside. This may, if necessary, be carried in the pocket and the amounts passed at each micturition be noted; * * * in acute parenchymatous nephritis the amount is at first much diminished, and then gradually increases with the diminution of the inflammation up to the normal amount; with convalescence it exceeds the normal considerably; and finally, in those cases which terminate in recovery with complete restoration of the kidney to a healthy condition, it falls again to the normal.

"In chronic parenchymatous nephritis the amount of urine is always below normal, any increase above normal rare or temporary. With the increase of the disease accompanied by increasing dropsy, the amount is very small and the urine concentrated; but when the progression is not active the amount is but little below normal.

"In both interstitial nephritis and amyloid degeneration the amount of urine is largely increased, even to three and four times the normal amount except during a short time previous to death when the quantity may be

less than normal. In complicated cases, which are far more common than uncomplicated ones, the amount of urine varies according to the nature and extent of the complicating affection. * * * The result of the admixture of chronic or acute parenchymatous nephritis with either the interstitial or amyloid degeneration, is to diminish the amount of urine and the amount of this diminution is dependent upon the extent of the parenchymatous complication * * * *

"If a parenchymatous affection exists as a complication of either an interstitial nephritis or an amyloid degeneration, it is almost sure to be detected by the increased amount of albumin and the character of the sediment; the measurement of the amount of urine is often in these cases of especial importance in making a diagnosis of such complications. If, for example, we have a specimen of urine with hyaline, granular, and fatty renal epithelium in the sediment, and at the same time the urine contains a considerable amount of albumin, it is impossible for us to say whether it is a case of pure chronic parenchymatous nephritis, or one of the other forms of Bright's disease in which the parenchymatous affection is merely a complication; but if we knew that the daily amount of urine averaged between 2000 and 3000 cubic centimetres, we might be reasonably sure that the parenchymatous disease was not the principal one but only a complication. If the parenchymatous affection is the principal one the amount of urine will be diminished, in which case it is impossible without the history of the case to determine the existence of any of the other forms of organic renal diseases.

"It is well known that Bright's disease is diagnosticated chiefly by the detection of albumin in the urine and renal

casts in the urinary sediment, and I frequently meet physicians at the present time who pronounce the existence of serious organic renal disease from these characteristics alone, which may occur without serious disease of the kidney. Daily measurement of the urine in these cases is of very great assistance. In hyperæmia of the kidneys, for instance, due to disease or abnormal condition of some other organ we frequently find both albumin and casts, and a knowledge of the amount of urine may prevent an error in diagnosis and prognosis. In passive hyperæmia of the kidneys, due to cardiac or other disease we find in the urine, so far as the kidneys are concerned, only hyaline and finely granular casts and a trace of albumin—conditions which are only found in the interstitial and amyloid forms of Bright's disease; but the average daily amount of urine in passive hyperæmia is diminished, while in the above-mentioned organic diseases it is much increased.

"In active hyperæmia of the kidneys, due to the elimination of some virus or drug, the amount of urine is usually diminished, owing to the febrile complication, and in addition to the sediment mentioned above in cases of passive hyperæmia, we find free blood and renal epithelium and usually an occasional blood and epithelial cast; albumin is present only in mere traces.

"These characteristics of the urine and sediment are the same as those of acute nephritis, but in the proportion which they occur in the stage of convalescence, when in acute nephritis the amount of urine is increased, and often much increased, while in this condition of hyperæmia it is almost always diminished. * * *

"I have known a diagnosis of chronic Bright's disease to be made in a case of cerebral disease, in which the

urine contained a trace of albumin and the sediment hyaline casts with blood and renal epithelium; yet the amount of urine was about normal and more than fifty grammes of urea were being eliminated—a condition of things which should lead one to give at least a doubtful diagnosis, so far as the kidneys are concerned, and to wait for time to show whether a temporary or a permanent affection existed. In this case the casts and albumin have entirely disappeared.

"In typhoid, rheumatic, and other fevers we often see in the urine a few hyaline casts and a trace of albumin, with a diminished amount of urine. In these cases parenchymatous disease of the kidneys can be eliminated by the character of the sediment and the proportion of albumin, and the same composition of the sediment can only be eliminated with absolute certainty by waiting until the fever has subsided and examining again, although a normal or increased amount of solids, with the diminished amount of urine, points very decidedly to the absence of any serious renal disease.

"In many cases of acute rheumatism, especially after the exhibition of salicylic acid and the salicylates I have found a trace of albumin in the urine, and hyaline and finely granular casts with blood and renal epithelium in the sediment. * * * I have seen some of these cases in which the casts and albumin entirely disappeared, but in which the diagnosis of chronic Bright's disease had been made; an error which would not have occurred had due regard been paid to the amount of work which the kidneys were capable of doing and to the average daily amount of the urine."

In rare cases of Bright's disease albumin may disappear

from the urine in the course of the disease; it is often the case that it diminishes in amount.

Hints for Diagnosis of Bright's Disease.—Urine permanently albuminous, when neither pyrexia nor thoracic disease, nor other condition exists which may account for the presence of albumin, is apt to indicate organic disease of the kidney. If an abundant deposit containing *casts* and much *renal epithelium* or numerous casts and cells in a state of fatty degeneration be also found, the proof is almost positive, if due regard to the *quantity* of urine and to the amount of urea excreted, be paid.

The lower the specific gravity in kidney troubles the more serious the case.

Sugar.—The sugar which is found in urine is not cane sugar, but more closely resembles grape sugar or glucose, hence the term glycosuria. Glycosuria (sugar in the urine) is a very different thing from diabetes mellitus; sugar in the urine may often be found when the patient has not diabetes mellitus, but the latter malady seldom exists without sugar in the urine. Sugar may appear in the urine as a result of the following diet: immoderate use of starchy and saccharine food; generally the amount of sugar in such cases is very small *but occasionally large amounts have been known to appear.*

Diseases not Diabetes Mellitus in which Sugar may Appear Temporarily in the Urine:

I. Cerebral disturbances, or those of the nervous system in general, especially of the medulla.

II. Disturbance of various bodily processes: diminution of respiration and absorption of oxygen; excessive production of sugar by the liver; diminution of the alkalies in the blood.

III. Pregnancy and child-bed.

IV. Plethora, especially of women at menopause.

V. Old age.

VI. Skin diseases: suppurative stage small-pox, suppurations generally, eczema of the genitals.

VII. Tetanus rheumaticus and intermittent fever (temporarily).

VIII. Various disorders: hepatic or gastric troubles, typhus, malarial fever (6 to 8 grammes to the 1000 cubic centimetres of urine at most), pneumonia, acute febrile processes.

IX. Convalescence from cholera, rongeola, and erysipelas, (amount small).

X. In various diatheses: phthisis, syphilis.

XI. Rheumatic gout and rheumatism; if the gout becomes *atonic* danger of diabetes mellitus.

XII. Gangrenous and ulcerative processes: uterine ulcers, severe burns.

XIII. After paroxysms of whooping cough, asthma or epilepsy.

XIV. After miscellaneous mishaps: blow in the epigastrium, disordered digestion, intense grief, sudden mental shock, exposure to cold, hereditary influence.

Agents which may cause Sugar to Appear in the Urine:

I. Oil of turpentine.

II. Chloral hydrate and various anæsthetics.

III. Nitro-benzol.

IV. Carbonic oxide gas (poisoning from).

V. Amyl nitrite.

Diabetes Mellitus.—In diabetes mellitus large amounts of sugar may be persistently present in the urine; the flow of urine is enormously increased, there is emaciation, great thirst, etc., in typical cases. If the urine of a patient *persistently* contain sugar, while at the same time other well-

known symptoms are present, there is reason to fear diabetes mellitus. In rare cases sugar may be absent.

Diet which Increases Sugar in the Uaine (to be Avoided by Diabetics):

All substances containing sugar: sugar, sirups, preserves, sweet wines, champagne, beer, cider; fruits containing sugar, as raisins, figs, bananas, pine-apples, melons; farinaceous foods, as bread, pastry, dumplings, rice, macaroni, vermicelli, tapioca, potatoes, carrots, lentils, kidney beans, etc. (Hardy.)

Diet which does not Increase Sugar in the Urine (to be Used by Diabetics):

Boullion, cabbage soup, bisque soup, game, fish, poultry, string beans, spinach, asparagus, tea and coffee with glycerine instead of sugar; slightly acid fruits, peaches, cherries, currents; Bordeaux and Burgundy wines, red wines; alkaline mineral waters (in *early stages* of the disease).

The *amount* of urine in diabetes mellitus may vary from eight to fifteen pints, occasionally *over thrity* pints; the *specific gravity* is generally very high, 1030 to 1052, generally about 1040; the *color* is apt to be pale, the *odor* faintly agreeable like that of new mown hay; the urine *froths* readily when poured from one glass to another.

The urine is itself generally clear and its taste sweet.

When the excretion is considerable in amount, exceeding four or five pints, the color may be described as a pale straw tint and the aspect of the urine is noticeably bright, but where the quantity passed is less than this, the ordinary color obtains; the average quantity of sugar passed daily ranges from 15 to 25 ounces, although more than *two pounds* have been observed.

If the quantity of sugar is large a sweetish, whey-like

odor is noticed; sediments are rarely observed in diabetic urine. (See Fungi.)

Freshly passed diabetic urine is usually neutral or alkaline but soon becomes strongly acid owing to fermentation; if a bottle be filled with diabetic urine, corked and set in a warm place, so much carbonic gas may be generated as to flow out the cork. Cloths soaked in diabetic urine, when dried, become sticky and look as if they were coated with honey.

Albumin and Sugar Together.—Th. Frerichs finds albumin occurring together with sugar under three conditions:

I. Glycosuria.

II. Diabetes mellitus.

III. Chyluria.

Albuminuria is a frequent complication of glycosuria, according to Frerichs, occurring in fifty per cent of such cases.

Glycosuria may occur in the course of acute and chronic cerebral affections, and with it Frerichs found albuminuria in (i.) aneurism of brain rupturing into ventricles, (ii.) extensive apoplectic effusions, (iii.) purulent general meningitis, (iv.) chronic tubercular basilar meningitis.

In acute cases the prognosis is occasionally favorable, most so in meningitis, but in chronic cases unfavorable as a rule. Nephritis rarely complicates diabetes mellitus —in five per cent only of the cases observed by Frerichs. All cases of diabetes mellitus complicated with phthisis and albuminuria terminated fatally; others where the albuminuria depended on cystitis and subsequent nephritis ended in recovery. In chlyuria (chyle in the urine) albumin, sugar, and fat may be found in the urine.

Bile.—The presence of bile coloring matter in the urine

is of slight clinical importance and the occurrence of bile acids very rare. In icterus and in phosphorus poisoning, also after severe burns, bile may be detected in the urine, but the demonstration of its presence there is not the only means of diagnosing these conditions, as may readily be imagined. Urine containing bile pigments is richly colored, deep brown, reddish brown, greenish brown, dark green or grass green; it foams strongly on being shaken and colors unsized paper yellow or greenish.

DEPOSITS.

The terms *urinary sediment*, *urinary deposit*, are used to describe the various substances precipitated from urine (in which they are held in solution or suspension) when this fluid is at rest for a longer or a shorter time.

Normal urine on standing shows a light, scarcely visible cloud; when, however, a plainly visible turbidity is seen which, as the urine stands, shows a tendency to form a sediment, it is necessary to examine the same with a view to ascertaining the constituents of the deposit and their clinical significance.

Beale divides deposits into three classes:

I. Light, flocculent, transparent, voluminous deposits: mucus and epithelium, spermatozoa, vibrions, fungi, casts.

II. Dense, opaque, bulky: urates, pus, phosphates.

III. Granular or crystalline, small bulk, sinking to bottom or deposited on sides of the urine glasses: uric acid, calcium oxalate, triple phosphate, cystin, lime carbonate, blood corpuscles.

N. B.—A very thick, glairy, gelatinous deposit is pus altered by the action of ammonium carbonate.

The distinction between the first two classes is easily

made, inasmuch as urates, pus, and phosphates, Class II, soon sink to the bottom of the urine glass, leaving a stratum of clear urine above them, whereas the constituents of Class I. are so light as to require a long time for settling, and even then, the supernatant urine will not be as clear as in case the deposit were of Class I. The essential characteristic of deposits of Class III. is their very small bulk compared with that of the others.

By noticing to which of these three classes a sediment seems to belong, the physician may gain considerable time in his chemical or microscopical examination of the same.

The order in which the constituents of sediments will be described is as follows:

Phosphates, Urates, Uric acid, Calcium oxalate, Calcium carbonate, Fats.	Unorganized sediments.
Mucus, Epithelium, Tube casts, Blood, Pus, Spermatozoa, Fungi, Entozoa.	Organized sediments.

Phosphatic Deposits.—A deposit of phosphates in the urine indicates an alkaline or neutral condition of the secretion which if occurring after a meal or after partaking largely of fruit, carbonates, citrates, or acetates of the alkalies is of no clinical importance. If, however, a deposit be seen daily for some little time with an alkaline reaction of the urine, examine with the microscope: if

the deposit be (i.) *amorphous*—i. e., containing no crystals—nervous exhaustion as from severe study or loss of sleep may be indicated, provided copious draughts of mineral waters had not been taken; if the deposit be (ii.) crystalline and consist of (*a*) calcium phosphate, it may be due merely to diet rich in lime, or else to disease of the spinal cord and chronic vesical affections; if the deposit be crystalline and consist of (*b*) ammonium magnesium phosphate it is of considerable clinical significance, if occurring in freshly passed urine.

Ammonium Magnesium Phosphate.—When the urine is alkaline from the presence of *volatile* alkali, i. e., ammonia formed from decomposition of urea, we have in addition to the deposit of phosphate of lime, crystals of ammonium magnesium phosphate—"triple phosphate" as it is sometimes called. The presence, therefore, of crystals of triple phosphate when *persistent* in the urine is indicative of *local disease* of the urinary organs and not of constitutional disturbance.

Diseases in which Triple Phosphate is Deposited in the Urine:

I. Retention of urine (after).

II. Paralysis of the bladder.

III. Formation of calculus.

N. B.—A deposit of triple phosphate in stale urine, o that received into dirty chamber vessels is of no clinica significance as regards the above three conditions. Moreover, a *dirty catheter* may be responsible for fermentation of the urea in the urine while in the bladder and triple phosphate may appear. In order, therefore, to form a correct idea of the clinical significance of this substance it must be discovered in *urine freshly passed into a clean vessel.*

Urate Deposits.—Patients often complain of a "brick-dust" sediment in the urine, and this lurid deposit causes them much uneasiness, suggesting by a logical (?) process the presence of the terrible destroyer "Bright's disease"; practitioners having "the wisdom of a serpent" should thoroughly appreciate the fact that *occasional* "brick-dust" sediments are as "harmless as a dove"; they may be due to one or more of the following:

Causes of an Occasional Brick-Dust (Amorphous Urate) Sediment in the Urine:

I. Over-eating or drinking; also prolonged abstinence from food and drink.

II. Great exertion, revelry or excitement.

III. Hard study.

IV. Fright.

V. Change in the manner of living; getting out of a warm bed into a cold room.

VI. Profuse perspiration with diminution of amount of urine.

A *frequent* or *persistent* "brick-dust" sediment should on the contrary receive the most careful attention of the busy practitioner.

Diseases in which Urates are Deposited in the Urine:

I. Febrile disturbances; "colds," fevers, inflammatory diseases; here we may include pulmonary emphysema, ordinary fevers, capillary bronchitis, diphtheria, dysentery, influenza, intermittents (febrile stage), nephritis, scarlet fever (at eruption), tetanus, acute polyarthritic rheumatism, after severe burns, etc.

Diseases in which Urates may be Steadily Deposited in the Urine:

I. Non-inflammatory disorders: (i.) Chronic affections,

heart, liver, spleen; (ii.) Digestive disturbances in children (milky white urates); (iii.) Incipience of gravel or calculus.

"The presence of uric acid and of urates in the urine in form of deposits is one of the most constant signs of functional derangements of the liver."

In a word, then, sediments of urates of pathological import usually occur in febrile states, or febrile exacerbations of chronic diseases; in such cases we find, as a rule, a diminished amount of urine, of strongly acid reaction; the color of the sediment may vary from clay to brick red, rose red or cinnamon; the richer the color the more the evidence of functional organic derangement; the paler the color, the worse the condition of cutaneous functions, usually. Blows in the region of the kidneys, fatigue or congestion of these organs, due to local causes, may cause urate deposits which if occurring *in the bladder* tend, of course, toward formation of stone. In most cases where urates are *steadily* deposited and no febrile or inflammatory symptoms are present, incipient gravel or calculus is indicated and usually disease of some abdominal organ is apt, at the same time, to exist.

The urates of which we have been speaking thus far are the amorphous or non-crystalline, but occasionally in gout and in some febrile attacks, especially of children, when the urine is scanty, high-colored of high specific gravity, and long retained in the bladder, the *crystalline* sodium urate (Fig. 10) may be found. "This substance being precipitated within the urinary renal passages is an unwelcome visitor, irritating, as it may, the mucous membrane of the bladder and urethra with its bristling crystals; it has been known to occlude the urethra with impacted masses of its deposit and the frequency of vesi-

cal calculi in children may possibly be due to the occurrence of this deposit."

(In examining urate deposits microscopically always procure fresh urine, not over a day old, since various forms of crystalline urates may be deposited at the end of acid fermentation and at the beginning of and during alkaline.)

Ordinary amorphous urates appear as irregular particles of granular powder; to tell them from amorphous calcium phosphate, add acetic acid—the phosphate is dissolved but the urates gradually turn into *uric acid.*

Free Uric Acid as a Sediment.—Uric acid, in a free state, i. e., uncombined with sodium, potassium, etc., is frequently found as a deposit in the urine, *normally so when the urine has entered the condition known as acid fermentation,* i. e., when twelve to twenty hours old.

Deposits of uric acid depend upon changes in the urinary secretion. (Ralfe.)

Deposits of Uric Acid in the freshly-passed Urine:

I. Due to *absolute increase* in the acidity of urine: (*a*) Occasionally in winter, action of skin checked, acidity of the urine increased and uric acid deposited; (*b*) eczema, psoriasis and other cutaneous disorders; (*c*) all forms of dyspepsia associated with irregular secretion of gastric juice. ("Acid dyspepsia."—Ralfe.)

II. Due to *relative increase* in the acidity of the urine: (*a*) Summer weather, when perspiration being increased, amount of urine is diminished and uric acid deposited; (*b*) for same reason in febrile and inflammatory disorders, especially in rheumatic fever and in diarrhœa; (*c*) alternating with appearance of sugar in the urine—sugar disappearing, uric acid is deposited, and vice versa; (*d*) in

urine of ill-nourished or strumous children caused by deficiency of alkaline phosphates.

Hints for Diagnosis.—If the deposit of uric acid occur *before the urine cools or immediately after it*, the formation of gravel or stone is to be dreaded.

If the deposit occur three or four hours after the urine is passed, gravel and stone are not so much to be dreaded.

If the deposit occur twelve to twenty hours after the urine is voided, when acid fermentation has set in, it is perfectly normal.

According to Anstie, nothing is more common in neurotic patients, without rheumatism, than a fluctuation between lithiasis and oxaluria from defective secondary assimilation of food.

In gout, uric acid and the urates are held back, but after the paroxysm, are often voided in great abundance.

Calcium Oxalate.—Fuerbringer shows that oxalic acid in small quantities is a normal constituent of urine. Oxalate of lime (lime and oxalic acid combined) deposits, on the contrary, are, if *persistent*, of pathological significance. *Occasional* deposits of lime oxalate may be due to physiological causes:

I. Derived directly from food by the ingestion of substances containing oxalate of lime, as cauliflower, bananas, carrots, apples, asparagus, turnips, onions, rhubarb, garlic, tomatoes, sorrel, gooseberries, water cresses, parsnips, etc.

Persons in weak health eating heartily of these vegetables will often have an attack of indigestion in consequence, and lime oxalate crystals will temporarily appear in the urine.

II. Derived indirectly from food, incomplete oxidation of sugars, starches, and fats ingested.

Sugar, starch and fat are, it is known, converted finally into carbonic acid and water in the system; any check to this process of conversion will lead to the appearance of oxalate of lime crystals in the urine, which will in due time disappear without any apparent alteration of health.

III. Certain drugs, as gentian, rhubarb, squill, valerian, and many others; alkaline waters, carbonated drinks, fermented liquors, sparkling wines, may be responsible, if taken, for the appearance of lime oxalate crystals in the urine.

Diseases in which Oxalate of Lime may be Deposited in the Urine:

I. Febrile disorders.

II. Pulmonary and cardiac affections in which respiration is impeded.

III. Disorders of the hepatic functions.

IV. Depressed conditions of the nervous system.

In these disorders the urine is generally of a deep orange color, of high average specific gravity, containing excess of urea and phosphoric acid and generally turbid with mucus and urates; the deposits of oxalate of lime are not always persistent, often disappearing for a few days to return again in great abundance.

Besides the disorders just mentioned, oxalate of lime crystals may be found in the urine of (i.) spermatorrhœa and (ii.) dyspepsia (certain forms).

It is to the latter of these two diseases that the term "oxaluria" properly belongs, while to the derangements associated with *uric acid* deposits the term "lithæmia" is given.

According to Ralfe the victims of oxaluria are most frequently country patients, especially those residing in damp and marshy districts or on cold, ill-drained clay

soils; situations, in fact, in which catarrhal affections of the intestinal canal are likely to be engendered. The urine is usually of a pale greenish color, the quantity in twenty-four hours normal, likewise the specific gravity. Its chief characteristic is the deposit of crystals of oxalate of lime which are found most abundantly in the morning urine passed on first rising. Owing to the presence of these crystals causing irritation of the mucous membrane of the bladder, micturition is frequent and urgent, though the quantity of urine passed is not large.

Patients suffering from oxaluria experience considerable mental depression and various anomalous symptoms indicative of nervous disturbance, as burning sensation across the loins, tightness and dragging around the abdomen, shooting and burning pains in the lower limbs, twitching of certain groups of muscles, with often a feeling of numbness, deadness and coldness. Treatment directed to the relief of the dyspeptic condition may result in improvement, enabling the physician to differentiate this disorder from early stages of locomotor ataxy.

Summary.—Oxalate of lime crystals may be found in the urine as follows:

I. After ingestion of certain articles of diet; of certain drugs.

II. After incomplete oxidation of sugar, starch and fat. Regulation of diet, change of air, etc., improve this condition.

III. From increased tissue metabolism as shown by increase of urea and phosphoric acid, found in many disorders of liver, heart and lungs—*high-colored urine.*

IV. Spermatorrhœa.

V. Persistent deposits of oxalate of lime in those cases

of dyspepsia to which the term "oxaluria" is applicable—*light-colored urine.*

A *constant and large* deposit is proof of an abnormal condition which renders the formation of oxalate of lime ("mulberry") calculus possible.

Remarks of Bouchardat on Urinary Sediments.—Bouchardat calls attention to the fact that persistent deposits (*gravel*) in the urine, of urates, oxalate of calcium, and triple phosphate indicate a superfluous amount of these substances in the circulatory apparatus, and deaths from embolus, sanguineous or serous effusions into the encephalum may take place in such cases; softening of the brain and senile gangrene may be due to capillary emboli caused by a deposit of these substances in the minute vessels of the brain; ecchymosis of the retina in glycosuric amblyopia, accommodative asthenopia, paralysis of the accommodating muscle, and pareses of accommodation would appear to be due to the same cause.

Fat.—Rassman divides the affections in which fat occurs in the urine into three classes:

I. *Chyluria*—parasitic and non-parasitic—where albumin and not infrequently fibrin are found.

II. *Fatty degeneration* at some point of the urinary apparatus—also where pus from an old abscess finds its way into the urinary passages.

III. *Constitutional affections* associated with marked cachexia or dependent on systemic intoxication, as:

(i.) Phthisis.

(ii.) Long-continued suppuration.

(iii.) Pyæmia.

(iv.) Yellow fever.

(v.) Poisoning by phosphorus, by carbonic oxide gas (or after poisoning from external use of carbolic acid.—Weiss.)

(vi.) Chronic poisoning by turpentine.

(vii.) Severe injuries to the bones.

In regard to *chyle* in the urine very little is known; its presence is not necessarily unfavorable, except when accompanied by coagulated fibrin and renal casts. It may occur during the course of epilepsy, erysipelas, diabetes, tuberculosis and other maladies. O. Bowen in the *British Medical Journal* reports a case where free oil appeared in the urine of a young person who was taking cod-liver oil, ceasing when the latter was discontinued.

Large amounts of oil in the urine may indicate not only an abscess opening into the urinary tract, but also may show that there is sloughing going on sufficient in extent to set free the oil of the fatty tissue; a case presenting the above conditions is reported by Dr. Cushing, of Boston.

Such cases as the above are rare and, in general, unless the urine be chylous, no great amount of fat is usually found.

When we see fat drops floating on the surface of a specimen of urine, it is well, before making a diagnosis, to be sure that unclean, oily or fatty urine glasses, chamber vessels, medicine glasses, etc., have not been used; if the urine has been drawn off with a catheter freshly oiled, oil may be found in the urine.

Mucus.—It will be remembered that a scarcely perceptible mucus "cloud" is normal in urine; when, however, this is distinctly visible and readily characterized, a pathological condition of the urinary passages is indicated.

Conditions under which Mucus is Present in Abnormal Quantity in the Urine:

I. Irritation of the mucous membrane of the urinary passages in general: vesical catarrh (mixed with pus).

II. Irritation of genital mucous membrane (in women).

III. After gonorrhœa: (long mucus plugs).

IV. Fevers and acute diseases: pneumonia, pleuritis, typhoid fever, meningitis, intermittents, pulmonary and intestinal catarrhs, acute delirium, epilepsy.

Inasmuch as irritation of the urinary tract may develop into inflammation, it is of great importance that the practitioner be able to tell whether he have *mucus* present in a specimen of urine (irritation) or *pus* (inflammation); if he find large quantities of mucus he may be able by proper treatment to prevent the irritation of the mucous membrane of the urinary tract from developing into inflammation, and if pus be passed it is important not to mistake it for mucus.

Detection of Mucus:

I. Examine the deposit, collected in the usual manner, with a power of from 200 to 500 diameters; if leucocytes (generic term for white blood corpuscles, pus corpuscles, or mucus corpuscles) be seen, either mucus or pus is present; add a drop of acetic acid and if pale, delicate fibrillated or finely punctated bands or threads, sometimes tortuous and frequently anastomosed, appear (Fig. 14), (precipitated mucin) mucus is present and the corpuscles will now show nuclei; pus is not excluded by this examination, since the pus corpuscles are of the same form as the mucus corpuscles and act the same way with acetic acid, namely, show nuclei.

II. **Mucus, Pus, or both?**

Thus far, then, it has been decided that mucus is present and possibly pus also; next, filter the urine and set the filter paper aside to dry. Now test the filtered urine for albumin and if any be found, pus is in all prob-

ability present; if none be found mucus is present, as determined by the microscope, but pus is not. Some times the albumin of pus is so small in amount as to escape the notice of the person testing. Mucin is not precipitated by mercuric chloride but pyin is.

Mucus is often present in considerable amount in the urine without betraying itself by causing any turbidity; to ascertain whether this be true, add to comparatively fresh urine acetic acid which will cause a cloudiness which will clear on subsequent addition of hydrochloric acid.

In II. we directed the filter paper to be dried; if a glistening "varnish" be seen adhering to it after it is dried, mucus in abnormal amount is indicated. The use of the microscope will confirm the chemical tests for mucus; the mucus "cloud" with a power of 450 to 500 diameters shows besides corpuscles, epithelial cells and fatty droplets, a very pale, almost invisible substance; the addition of a drop of acetic acid causes the corpuscle nuclei to appear, the epithelia to grow paler, and the pale substance to become fibrillary or finely punctated.

We wish to call attention again to "muco-pus" which must not be mistaken for mucus; when, as in vesical catarrh, a glairy deposit is found adhering closely to the sides of the vessel, this is not mucus alone but a mixture of pus and mucus rendered glairy by the action of carbonate of ammonium. As has been observed before, this substance cannot be dealt with chemically or microscopically to any advantage; the most we can do is to filter the urine and test for albumin which if present in small quantities indicates the presence of pus; also observe whether triple phosphate crystals are present.

If we desire to know where mucus comes from, the

character of the epithelial cells always present in it may aid us, although any arbitrary classification is impossible. These are:

I. Round cells from urinary tubules of kidney and deeper layers of the mucous membrane of the pelvis of of the kidney, and are complete spheres with nuclei.

II. Conical and tailed cells from pelvis of the kidney, twice as long as broad and broader at one end than at the other, with spindle-shaped prolongation at one end or both.

III. Flat cells from vagina or bladder, described as irregular, polygonal lamellæ, with distinct nuclei situated nearly in the centre.

IV. Epithelial cells of urethra are like those of kidney, but albumin is usually present with the kidney cells and not with the urethral.

Epithelium.—A sediment occurring in the urine may contain epithelial cells from various portions of the urinary tract.

Diseases in which Epithelium is increased in the Urine:

I. Affections of the kidneys: serious if abundant and accompanied by albumin, blood, casts, etc.

II. Affections of the ureters: serious when as in I.

III. Leucorrhœa or specific inflammation of vagina.

IV. Catarrhal inflammation lining membrane of the bladder.

V. Catarrhal or specific inflammation of urethra.

VI. Strumous diathesis: female children.

It must be carefully noted that an abundant, amorphous-looking, light, cloudy deposit, consisting of epithelial cells from the vagina, is found in the urine of females when none of these diseases may be present; this deposit will be greatly increased in leucorrhœa.

In acid urine the epithelial cells are preserved for some length of time, but in alkaline urine they are gradually destroyed, becoming first swollen and transparent.

If, together with casts and albumin, the round cells are found, they have probably come from the uriniferous tubules, or if there are symptoms of impacted calculus, from the pelvis of the kidney; otherwise from the urethra, Cowper's gland, or the prostate.

Tube Casts.—A urinary sediment may contain tube casts; these are cylinders or moulds formed in the uriniferous tubules and consisting of some transparent material which is formed in or poured out into the canal and there made firm, entangling in its meshes whatever may be in the tube at the time of its effusion.

Their presence in the urine is significant of congestion or inflammation of the kidney; this may be (i.) temporary or (ii.) permanent. Constant presence of tube casts in the urine may indicate serious trouble, if albumin, blood, etc., occur, and the quantity of urine is abnormal.

Diseases in which Tube Casts Appear in the Urine:

I. All cases of renal congestion and in acute or chronic Bright's disease.

II. Acute diseases (temporarily): bronchitis, pneumonia, convalescence from scarlet fever.

III. After heavy doses of various drugs.

IV. Purulent infection (some forms); icterus after attempt at asphyxia with charcoal.

Classification of Casts.—Description.—Voluminous, of greater or less length (rarely exceeding $\frac{1}{50}$th of an inch); variable aspect; pale or hyaline, granular or covered with epithelium; sometimes distinctly, sometimes indistinctly outlined; generally round or club-shaped extremities:

- (*a*) Very pale or transparent amorphous, cylinders.
  - With badly defined margins, often twisted or varicose branching and subdividing.
    - Uncolored by carmine. — *Mucus casts.*
  - With clear, well-defined margins, sometimes intersected by fractures.
    - Colored by carmine — Hyaline or waxy casts.
- (*b*) More or less dark epithelial or granular cylinders (200 to 400 diameters).
  - No line of contour; epithelial cells united into into a cylinder. Never very narrow. — Epithelial or granular casts.
  - A more or less distinct line of contour; fundamental substance, finely granular, studded with blood corpuscles. — Fibrinous or blood casts.

Any of the above may undergo fatty degeneration.

Bright's Disease and Tube Casts.—In acute desquamative nephritis we may expect to find epithelial casts, as well as both large and small hyaline casts, blood and oil casts; when the acute desquamative nephritis has passed into the chronic state albumin may be present in the urine, but not necessarily casts, for several years. As the chronic disease progresses the urine loses its normal color and grows more or less colorless, the deposit more dense and copious, containing large granular and hyaline casts indicative of granular contraction of cortical portion of the kidney.

A few oily casts and cells, together with other casts, have no special unfavorable significance, but if albumin be found steadily for weeks and months, and oil casts

preponderate in the deposit, there is reason to fear *fatty degeneration.* After scarlet fever in some cases, instead of the desquamative tubular nephritis which often results, we may find what is called *glomerulo-nephritis,* indicated by presence in the deposit of *white cell casts.*

The *small, red, granular* kidney is indicated often by copious amount of urine of low specific gravity, not always much albumin, granular casts and scattered epithelial débris, and late in the disease often large hyaline casts.

Lardaceous degeneration is not always easy to diagnose from the urine which, however, may be copious, clear and containing no sediment, but in most cases a light cloud can be seen containing small, hyaline, and finely granular casts with, occasionally, oil casts and cells. It is well to bear in mind that Bright's disease should not be diagnosed solely from observation of certain conditions in the urine; it is not the province of this work, however, to dwell upon the dropsy, condition of the eye, headache, giddiness, twitching or cramp in certain muscles, dry, harsh skin, condition of heart, etc., which may be found in the course of the malady.

Hæmoglobin in the Urine.—In certain diseases and after poisoning by certain substances, the coloring-matter of the blood may be found in the urine. Such a condition is termed *hæmoglobinuria,* and differs from "blood" in the urine in that no blood *corpuscles* can be detected with the microscope, the coloring matter alone being present. In such cases the urine may vary in color from red-brown to inky black.

Circumstances under which Hæmoglobin may be Found in the Urine:

I. Severe scurvy and purpura hæmorrhagica.

II. Typhus with dissolution of the blood; septic fever.

III. After scarlet fever, after transfusion of blood, and occasionally in hemophilia.

IV. Epidemically, as a disease among the new-born.*

V. As a paroxysmal disease after exposure to cold or under certain malarial conditions (especially in young males).

VI. After poisoning by (i.) phosphorus, (ii.) copper sulphate (Starr), (iii.) carbonic acid, hydrocyanic acid and arseniuretted hydrogen gasses (inhalation of).

VII. In chronic lead-poisoning.

VIII. After injection of glycerine into the blood.

The temporary presence of this substance in the urine is not alarming but when it occurs *permanently* the prognosis is doubtful.

Before the diagnosis of hæmoglobinuria is made the urine should be carefully examined for blood-corpuscles; if none be found some of the granular matter which may form the sediment should be dried on a glass slide, common salt rubbed into it, a hair laid across, a cover glass applied, and a drop of glacial acetic acid allowed to enter beneath the cover. If the slide be then warmed and subjected to examination with a power of 600 diameters, crystals of hæmin will be seen. Hæmin crystallizes in rhomboidal tubes. Further examination of some of the sediment, with the spectroscope, will bring out the two absorption bands between D and E, characteristic of oxyhæmoglobine.

Blood.—Blood itself may occur in the urine under the following conditions:

I. Kidney troubles, as (i.) acute Bright's disease, (ii.)

* Seventy-eight per cent of babes born in Dresden during March and April, 1879, died of it.

active or passive congestion, (iii.) cancer or fungous growths, (iv.) tubercle, (v.) calculus in pelvis of kidney or in ureter, (vi.) parasites, as *Bilharzia hæmatobia*, (vii.) pyelitis, (viii.) cancer of the pelvis and ureter, (ix.) traumatism.

II. Bladder and urethral affections.

III. External injury or violent exercise.

IV. Administration in large doses of certain drugs, as cantharis, potassium chlorate.

V. Supplementary to hæmorrhoids, or asthma.

VI. Menstruation, uterine or vaginal hæmorrhage.

VII. Intentionally mixed with the urine for the purposes of deception.

Urine containing blood will show with the aid of the microscope, blood corpuscles; in such cases the term *hæmaturia* is used.

Urine containing blood will also contain *albumin*, since blood contains albumin; the physician should not, therefore, jump at the conclusion that Bright's disease is present from finding albumin in urine, which also contains blood.

The following table may aid in the diagnosis of blood in urine:

From Kidneys.

BLOOD PASSED.	CHARACTER OF URINE.	PAIN, ETC.
Bloody urine with elongated clots from ureters, is generally albuminous, usually tube casts	Urine smoky or blackish-brown, if acid; bright red, if alkaline. Forms a brownish-red, pulverulent mass	Pain when moulds of clotted blood form in the ureters and are discharged in the urine.

BLOOD PASSED.	CHARACTER OF URINE.	PAIN, ETC.
present, and symptoms of renal disease. Blood brown colored or like porter, and not as profuse as when from bladder.	or deposit. Albumin is found as well as renal casts.	
Nephritic Colic.		
Frequently blood in urine from kidneys.	Constant desire to urinate. Sometimes blood clots in urine.	With pain in region of kidneys and along the course of the ureters.
Renal Cancer.		
Frequent and profuse bloody urine.	Pus and encephaloid matter present in the advanced stages.	Tumor found in the loins; and deep-seated pains.
From Bladder.		
Blood in small flaky clots, not mixed with urine, but passing with it.	Urine ammoniacal; with tenacious mucus and phosphatic deposits—in feeble persons. Urine alkaline.	Dull pain in region of bladder and at its neck; frequent desire to urinate. Sometimes retention from a coagulum in the urethra.
Abrasion or Ulceration of Bladder.		
Blood mixed with mucus or pus in the urine.	Frequent desire to urinate and urine putrid containing more or less muco-purulent matter.	Acute burning pain in pelvic cavity, with uneasiness.

BLOOD PASSED.	CHARACTER OF URINE.	PAIN, ETC.
Malignant Disease.		
Blood dark-colored, with putrid, offensive matters.	Urination often difficult, painful, and with frequent desire to void the urine.	More or less severe pain in vicinity of the disease.
From Urethra.		
Blood coming without urine, in drops or in a small stream. Sometimes small clots.	The first jet of urine only is bloody, the balance becoming clearer and natural.	Perhaps soreness at the part from which the blood issues.
Vesical Calculus.		
Blood in urine after exercising; or a drop or two with pain in the last expulsive effort at urination, and with pain at the time.	Urine passed often during the day; apt to be of a florid color, and the desire to urinate caused by any movements or exercise.	Pain in penis or perineum, felt after (and often before) urinating, especially when pain is increased by exercise. Usually pain at end of penis.
Probable Prostatic Hypertrophy.		
Blood intimately mixed with urine, dark colored and not much altered by circumstances.	Urine frequent especially during the night.	More or less constant irritation at neck of bladder.
Chronic Cystitis or Chronic Inflammation of Neck of Bladder.		
Urine contains blood-corpuscles, if any hæmorrhage be present. Mucus increased.	Urine frequent and in small amount during the day (frequently alkaline, fetid).	Pain low down in belly. Slight pain in expelling the last drop of urine.

BLOOD PASSED.	CHARACTER OF URINE.	PAIN, ETC.
Chronic Prostatis.		
Blood rarely if ever passed.	Urination unduly frequent; a small muco-purulent discharge from urethra; urine a little cloudy.	Diminished sexual desire. Pain at end of penis. Dull pains in perineum and vicinity.
Distended Mucous Membrane of Bladder.		
	Urine difficult and incomplete; passes by drops involuntarily, but in full stream on catheterization.	Pain in penis or perineum felt before urinating.
Chronic Inflammation of Mucous Coat of Bladder.		
Blood occasionally observed, especially when ulcerations or abscesses have formed.	Urine passed often during the day in small quantities at a time; alkaline. Mucus increased.	Dull pain in region of bladder. Heaviness in perineum; weakness in back.

It is wise to have the urine passed into two vessels—say an ounce or two in the first and the balance in the second vessel.

In cold weather urates are often deposited in the urine giving it a lurid appearance which may probably frighten the patient into a belief that blood is present; application of gentle heat will cause the fluid to clear if the urates are the constituents of the deposit.

In case considerable albumin and tube casts are found together with blood, renal disease may be suspected (see Wood's Observations on Quantity). In bladde s

blood may be found and a small amount of albumin corresponding to the blood but no tube casts; likewise in urethral affections.

Pus.—According to Sir Henry Thompson, "pus may, and most commonly does, proceed from some local condition of the bladder." The abstract significance of pus in the urine is a suppurative process in the urinary tract (uropoietic system) or an abscess communicating with it.

The following table may be of value in determining the cause of pus in the urine:

PAIN, ETC.	OBSERVATIONS.
From Bladder.	
Symptoms of acute or chronic disease of the bladder, as strangury, etc.	Urine alkaline. Triple phosphates present in fresh urine. If urine be drawn off with catheter in severe cases spindle-shaped cells, smaller than the vesical epithelial cells and nucleated, will be found with microscope.
From Ureters.	
Slight colicky pains along the course of the ureter.	
From Urethra.	
That referable to gonorrhœa, etc.	Purulent fluid may be pressed out of the urethra, *between* micturitions and "*shreds*" may be seen in the urine.
From Vagina.	
Symptoms referable to leucorrhœa.	Abundant pavement epithelium of vagina, under microscope.

PAIN, ETC.	OBSERVATIONS.
From Kidney Pelvis.	
Lumbar pains. Absence of bladder or urethra signs.	Urine acid. Renal casts. Transitional epithelium seen with microscope.
From Kidney Parenchyma.	
Local symptoms very slight.	Long-continued presence of pus in urine.
From Abscesses Bursting into Urinary Passages.	
Symptoms referable to an abscess.	*Sudden* presence of large amount of pus in urine.

If pus be found in the urine for a few days and then disappear, we may conclude that the affection is superficial and not serious; if, on the other hand, pus be found steadily in the urine from day to day, some deep-seated and extensive alteration is indicated.

Spermatozoa.—Spermatozoids frequently may be found in the urine of males in a state of health. Constant presence of them together with other more important symptoms may indicate masturbation.

Conditions under which Spermatozoa are found in the Urine.

I. After coition or nocturnal emissions.

II. During typhus.

III. In so-called "spermatorrhœa."

Method of Collection.—Rouvier's method for collecting spermatozoa is as follows: Collect the urine for twenty-four hours, let it settle for two hours, decant the urine from the sediment, collect the latter in a test-tube and shake it up with ether. On standing the ether will come to the top, when on draining it off with a pipette and adding a few drops of distilled water the microscope will show the spermatozoa.

Cancer Elements.—In cases of cancer of any part of the urinary apparatus as the bladder, two different forms of cancer elements are sometimes observed: (*a*) isolated cancer-cells; (*b*) pieces of cancer-tissue.

Cancer-cells are of great variety of form often quite oddly formed; they may resemble epithelial cells of the urinary passages. It is only from an abundant appearance of peculiar and many-formed cells that a malignant growth can be recognized with any certainty.

Fragments of villous cancer may be seen in the sediment of urine.

If the tissue is well preserved, which it seldom is, under a power of 300 diameters a tree-like formation similar to fringe may be seen; usually, however, sloughed off and much altered pieces of tissue only appear in the sediment and the identification of these is very difficult.

If crystals of hæmatoidin (small rhomboid prisms insoluble in water, alcohol, ether, acetic acid, glycerin, dilute mineral acids and dilute alkalies, of a red or yellow color) be found imbedded in tissue in urinary sediment, the diagnosis of old hæmorrhagic and necrotic tissue, as found in villous tumors, may be made. Sometimes on treating necrotic cancerous tissue with glycerin, crystals of hæmatoidin may be seen, either as rhomboids or small, yellow, grassy tufts.

Sometimes with a low power, 120 diameters, thicker and darker colored, tuft-shaped, branching forms may be observed in necrotic flakes.

If the urine is strongly alkaline the villous tissue may be so changed and incrusted with phosphates that a diagnosis can scarcely be made.

Fungi:

Sarcinæ appear to be formed in the urine before it is

voided; they are found in both acid and alkaline urine generally associated with some disorder of the urinary organs.

Bacteria in the urine show that putrefactive changes have set in; the urine containing them soon loses its transparency and deposits a sediment of a cloudy appearance; its odor becomes offensive and the reaction soon ammoniacal.

Mould Fungus (Penicilium glaucum) is often found in acid urine and grows luxuriantly in albuminous urine.

Yeast or Sugar Fungus (Torula cerevisiæ) grows luxuriantly in diabetic urine exposed to a moderate temperature. It has been found in urine in which no sugar could be demonstrated.

APPENDIX.

The contents of the appendix are as follows:

Examination of Urinary Calculi.

Effect of Reagents on Normal Urine.

Changes in Normal urine on Standing.

What to Look for in the Urine in Disease.

Micro-chemical Summary (Deposits).

Rare and Occasional Constituents of the Urine together with Normal Constituents occurring in Small Amount.

Results of Analyses recently made by the Author.

Glossary of Terms used in Parts I. and II.

The Use of "Dry" Tests for Albumin and Sugar.

EXAMINATION OF URINARY CALCULI.

The chemical elements in calculi are the same as those in deposits.

Method of Procedure.

Reduce calculus to powder in agate mortar.

Place some of this upon platinum foil.

Heat in the flame of an alcohol lamp to a red heat.

If the heating is accompanied by a flame the calculus contains either: (*a*) fatty matters, (*b*) cholesterin, or (*c*) cystin.

Take some of the powdered calculus which has not been heated and treat it with ether; if it dissolves, *fatty matters and cholesterin* are indicated; if it does not dissolve, take a fresh amount and add ammonia to it; if it dissolves, *cystin* is indicated. Moreover, the odor of

cystin is nauseous, and its flame is bluish-green in color. Suppose now the heating of some of the powdered calculus was not accompanied by a flame, then the calculus consists of one or more of the following:

Uric acid,	Calcium phosphate,
Ammonium urate,	Ammonio-magnesium phosphate,
Sodium urate,	Calcium oxalate,
Calcium urate,	Xanthin,
Magnesium urate,	Fibrin.

To distinguish the members of the above list observe when heating to calcination whether (*a*) *no residue* is left, (*b*) a *slight* residue, or (*c*) a *considerable* residue. Calculi which, on being calcined, leave no residue are either

Uric acid	Xanthin or
Ammonium urate,	Fibrin.

Uric acid and ammonium urate calculi are distinguished from the two others by the murexid test; take a fresh amount of the calculus which has not been heated, place it on porcelain, add a little strong nitric acid, heat gently until evaporation, let cool, add ammonia. Magnificent red color indicates presence of uric acid or urates.

If the murexid test, carefully performed, gives no results take a fresh amount of the calculus and add solution of potassium carbonate; if it dissolves, xanthin is indicated; if it does not dissolve, test for fibrin which is soluble in caustic potash solution, has an odor of burnt horn and is precipitated from solutions by potassium ferrocyanide.

Those calculi which leave a *slight* residue on incineration are urates of sodium, calcium and magnesium, and may be recognized by the murexid test.

Those calculi which leave a *considerable* residue on incineration are calcium oxalate, calcium phosphate, ammonio-magnesium phosphate.

If the calculus is calcium oxalate a small portion of it will not dissolve in acetic acid; effervescence takes place when a drop of nitric acid is poured on a little of the residue after ignition.

Calculi of ammonio-magnesium phosphate and calcium phosphate ordinarily occur together and may be recognized by melting to a white enamel-like mass on incineration; hence a calculus composed of these two substances is called a *fusible* calculus.

Observations:

Calculi do not always consist of some one or two constituents, sometimes they contain several, hence before proceeding to examination of a calculus it is advisable to saw it in two through the centre with a jeweler's saw and notice whether it is built up of distinct layers or apparently consists of one substance. If the former is the case, carefully scrape off portions of each layer and examine them separately. If the calculus is in fragments, select fair specimens of about half a grain or a grain each and crush under the blade of a knife.

Most calculi have a nucleus which is sometimes a foreign body upon which the urinary sediments deposit and form a crust. Retained gravel may also become the nucleus of a calculus, in which case the nucleus will be apt to differ from the rest of the calculus in chemical composition. Sometimes the calculus has a vacant space in its interior; in this case the nucleus consisted of mucus which later became dry. In rare cases the nucleus rattles within the stone, which is to be explained in the same way, by the drying up of the mucus. Sometimes the calculus is made up of gravel or several small stones which are united by a cement, and which sometimes have

the same chemical composition as the calculus and sometimes a different one.—Vogel.

EFFECTS OF REAGENTS, ETC., ON NORMAL URINE.

Boil normal urine and it should be clear.

Acids (concentrated) added to the urine generate, on boiling the same, a peculiar nauseous odor and the urine becomes more or less dark.

Alkalies produce a cloudiness in the urine caused by precipitation of phosphates (earthy).

Barium chloride solution added to urine acidified with hydrochloric acid precipitates the sulphuric acid of the urine in the form of barium sulphate.

Silver nitrate solution added to urine precipitates the phosphates and chlorides as silver phosphate and silver chloride; if nitric acid be added to urine and then silver nitrate solution, silver chloride alone is precipitated.

Iron chloride solution precipitates the phosphoric acid if acetic acid has first been added.

Lead acetate solution precipitates the chlorides, sulphates and phosphates as lead salts; it is useful, therefore, when we desire for purposes of analysis to free the urine from these constituents.

Oxalic acid or oxalate of ammonium precipitates the lime of the urine as lime oxalate.

Mercuric nitrate produces in urine, from which the sulphuric and phosphoric acids have been removed, a cloudiness which disappears; further addition, now, of mercuric nitrate causes a white, insoluble compound of mercuric oxide and urea to separate.

Alcohol produces a cloudiness which disappears on dilution with water.

CHANGES IN NORMAL URINE ON STANDING.

After standing some time normal urine begins to change; fermentation, so-called, begins, due, according to Scherer, to decomposition of mucus from the bladder, forming a fungus very like the ferment Mycodermæ Cerevisiæ, and then the coloring matter decomposes.

In consequence of this the color of the urine usually grows paler, the reaction more acid, due to the fermentation of lactic and acetic acids; a sediment forms, red in color, consisting of uric acid, urates and mucus. These are the phenomena of so-called *acid* fermentation, but further on in process of time the so-called *alkaline* fermentation may set in—in some cases this may happen before and without acid fermentation—in which the urea of the urine is decomposed into acid ammonium carbonate and free ammonia; the urine acquires a strong ammoniacal odor and effervesces strongly on addition of acids. The sediment will now contain triple phosphate crystals, and, with the microscope, fungus threads, infusoria, and ammonium urate may be seen. Alkalies added to the urine in this stage cause an abundant generation of ammonia.

WHAT TO LOOK FOR IN THE URINE OF DISEASE.

If the urine contains *albumin* look with the microscope for tube casts and other evidences of kidney disease. If the urine contain a *small amount* of albumin it is well to be on one's guard lest *pus* or *blood* should be overlooked. In *albuminous* urine the sediment will often contain *fungi;* these should not be mistaken for blood-corpuscles. If the urine be pale, of *high specific gravity* and sweetis odor, test for *sugar.*

When a *large quantity* of urine is passed daily, containing no sugar, estimate the solids so as to recognize diabetes insipidus, if present. In acute febrile disturbances estimate the amount of *urea* from day to day, and examine deposit for *urates* in large amount; in inflammations attended by exudation, watch the *chlorides*; albumin is often found in these conditions and if the kidneys become involved, casts, cells, etc., and in severe cases, blood and pus corpuscles.

The re-appearance or increase of *chlorides* in an acute inflammation is deemed favorable; the appearance of albumin unfavorable.

Among many acute febrile processes there are certain ones where examination of the urine is of especial value; these are:

I. Icterus.
II. Acute atrophy of the liver.
III. Acute lung diseases.
IV. Heart diseases.
V. Peritonitis.
VI. Meningitis.
VII. Acute articular rheumatism.

I.

In Icterus look for biliary *coloring matters* in the urine; whether found or not, next examine the urine for *albumin*. If *albumin* be present the case is one of *icterus gravis* and small amounts of biliary acids may be detected.

II.

In Acute Liver Atrophy look for *leucin* and *tyrosin*, epithelial casts, fibrinous cylinders, kidney epithelium and isolated blood-corpuscles in the sediment; examine also for albumin which is generally very abundant. Test for

the chlorides which generally are absent. Urates and biliary matters will also be present.

III.

In Acute Lung Diseases the larger the amount of *urates* the more insufficient the respiration.

IV.

In Heart Diseases test for *albumin.*

V.

In Peritonitis look for increase of *indican.* (Senator.)

VI.

In Meningitis observe whether the specific gravity is high and whether on boiling the urine the *earthy phosphates* separate. (In typhus the earthy phosphates do not thus appear). The differential diagnosis between typhus and meningitis cannot invariably be determined as above.

VII.

In Acute Articular Rheumatism expect to find the *earthy phosphates* much increased; the sediment should contain rose-red urates and oxalate of lime colored by uroerythrin; if *pericarditis* be dreaded or exist, estimate the *chlorides* often. The earthy phosphates will decrease with the chlorides on advent of pericarditis, but the uroerythrin will appear still more beautiful.

In Non-Febrile Diseases and in *chronic* diseases for the most part, observe that the *color* of the urine is not dark reddish-yellow and *urates* are not present in large amount.

Among these affections the following possess certain characteristic peculiarities:

I. Chlorosis.

II. Hysteria.

III. Diabetes mellitus.

IV. Chronic diseases of the spinal cord.

V. Rachitis and osteomalacia.

VI. Bone diseases involving a great part of the skeleton.

VII. Chronic articular rheumatism.

VIII. Gout.

IX. Intermittent fever.

X. Chronic liver affections.

XI. Chronic skin diseases.

XII. *Scurvy* and *purpura hæmorrhagica.*

XIII. Melanæmia.

XIV. Leucæmia.

I.

Chlorosis shows a very pale urine of low specific gravity.

II.

Hysteria is like chlorosis, but at times the specific gravity is greater and a large amount of *indican* present.

III.

In Diabetes Mellitus test the urine for *albumin* which appears in considerable quantity in the later stages of the disease. In the sediment look for *fungi.*

IV.

In Chronic Diseases of the Spinal Cord test for increased *indican* and *earthy phosphates*

V.

In Rachitis and especially in *osteomalacia* some authors claim the *earthy phosphates* to be strongly increased and to form a copious sediment.

VI.

In Bone Diseases involving a great part of the skeleton, expect to find increase of *carbonate* and *oxalate* of lime in

the sediment and increase of *earthy phosphates* partly in solution and partly in sediment.

VII.

In Chronic Articular Rheumatism expect to find a sediment rich in *urates* and *calcium oxalate;* also a great increase of *earthy phosphates.*

VIII.

In Gout estimate the *uric acid* which is generally excreted in diminished amount; at times *free uric acid* is found in the sediment.

IX.

In Intermittent Fever during the *cold stage* an increased amount of light, clear urine is voided.

X.

In Chronic Liver Affections, even when no fever exists, the urine may be dark, acid, and of high specific gravity and diminished quantity.

Coloring matters are increased; in the sediment observe rose-red urates and often small amount of lime oxalate.

XI.

In Chronic Skin Diseases, especially if the function of perspiration is partly destroyed, test the urine for *albumin* and examine the deposit for evidences of kidney complications.

XII–XIII.

In Scurvy and Purpura Hæmorrhagica test for blood in the urine; also in *melanæmia.*

XIV.

In Leucæmia look for *uric, hippuric* and *lactic acids.*

MICRO-CHEMICAL SUMMARY.

(Unorganized Deposits.)

a. If a deposit is partly or wholly soluble in *acetic acid* look in a fresh amount of the deposit, to which nothing has been added, for triple phosphate and calcium phosphate.

b. If a deposit is slowly soluble in *acetic acid*, giving rise to colorless tablets of uric acid, look for urates.

c. If a deposit is insoluble in acetic acid, look for uric acid, hippuric acid, oxalate of lime, cystin, tyrosin (not too strong acid).

a. Triple phosphate: very large, transparent crystals, generally triangular prismatic in form. Found in *alkaline* urine only.

Calcium phosphate: generally *amorphous;* sometimes *crystalline* in pale, faintly *acid* urine with a tendency to alkaline fermentation. Crystalline calcium phosphate shows rods, either separate, in stellate groups or is sheaf-like bundles.

b. Urates are generally amorphous; the urate of soda may show "hedge-hog" crystals or prismatic crystals arranged in star-like masses. Found in *acid* and *neutral* urine.

c. Uric acid: large, red, yellow or brown crystals, generally four-sided rhombs; found only in *acid* urine; best seen with a low power, 100 or 200 diameters.

Oxalate of lime: very small, octahedral (letter envelope) or dumb-bell crystals, best seen with a power of from 400 to 600 diameters.

Cystin: colorless, hexagonal tablets overlapping one another; sometimes square prisms. *Soluble in ammonia* and in this manner differentiated from uric acid which is not.

Tyrosin: (generally) deep-yellow, fine, short, acicular prisms in bundles, tufts, sheaf-like collections or spiculated balls. They are insoluble in not too strong acetic acid.

Hippuric acid: very rare deposit in *acid* urine, resembles triple phosphate microscopically, but *insoluble* in acetic acid.

d. If a sediment contains none of the above or something else beside the above, look for: leucin, xanthin.

Leucin: (generally) yellowish spheres with sharp contours showing, with good light, radii and delicate concentric lines. *Insoluble in ether*; while fat (which leucin resembles microscopically) is *soluble.*

Xanthin: Whetstone crystals soluble on *heating.* (Uric acid not dissolved by heat.)

MICRO-CHEMICAL SUMMARY.

(Organized Deposits.)

a. If the urine is turbid when first voided, examine the sediment for *organized* bodies.

b. If with a power of from 400 to 600 diameters, small, *round* or *oval* bodies be seen, look for: red blood corpuscles, white blood corpuscles (leucocytes, pus corpuscles), fungus spores, spermatozoa.

Differentiation.—To a portion of the sediment add a drop of carmine solution; if the round or oval bodies become *colored,* to another portion of the deposit to which nothing has been added, add *acetic acid.* (This may be done by introducing a drop of the acid beneath the glass cover—see Introduction). If the bodies become pa and two or three *nuclei* appear, *leucocytes* are present the deposit.

If the round or oval bodies do *not* become colored by the carmine, to a fresh amount add dilute acetic acid; if the bodies swell, or shrink, presenting a "raspberry" appearance *without nuclei*, especially if transparent or of a faintly yellowish color, *red blood corpuscles* are present. (Verify by study of their appearance, characteristics, etc).

If neither carmine nor acetic acid causes any change in appearance, look for spermatozoa and fungi; spermatozoa have the general appearance of minute tad-poles; if the latter be not found, set the slide aside for a few days and if on re-examination the bodies have germinated, *fungi* are present.

c. If with the same power as in (*b*) *larger* bodies are seen, of variable form, such as round, oval, lamellar, cylindrical, fusiform, caudate or irregular, showing nuclei and granular contents, *epithelium* is present. Add *acetic acid* and the bodies become pale and the nuclei are distinctly exhibited. To a fresh portion of the sediment add carmine and they become colored.

d. If cylindrical bodies be seen, *tube-casts* may be present. (See Tube Casts, page 156.)

e. If with a power of 500 diameters and upwards *very small*, transparent bodies be seen, generally exhibiting active vibratory movements, *bacteria* may be present. Acetic acid arrests their motion.

f. If the bodies present a *filamentous* or *fibrillary* appearance, look for thallus of fungi, fibrin, mucus.

Differentiation.—To a portion of the sediment add *acetic acid;* if no change *thallus* may be present. If on addition of acetic acid a swollen, transparent, amorphous mass appear, *fibrin* may be present; if the appearance is more distinct and punctated or striated, *mucus* may be present.

RARE OR OCCASIONAL CONSTITUENTS OF THE URINE, TOGETHER WITH NORMAL CONSTITUENTS, OCCURRING IN SMALL AMOUNTS.

Among the *normal* constituents of urine occurring in small amount may be reckoned kreatin, xanthin, hypoxanthin (?), oxaluric acid, succinic acid, carbolic acid, iron, ammonium salts, silicic acid, nitrates and nitrites, hydrogen peroxide, various coloring matters.

Kreatin.—Not much can be definitely said about the physiological significance of kreatin; it stands nearer to urea than to the protein substances.

Xanthin.—This substance is found in normal urine in small amount; it is a rare constituent of deposits and calculi. When occurring as a deposit it appears under the microscope as small, oblong plates; it is soluble in ammonia, caustic potash and in the strong mineral acids, when heated. When xanthin is found in a deposit its significance is said to be liability to cause the formation of calculi containing it.

Hypoxanthin.—This is a substance closely allied to xanthin.

Oxaluric Acid.—This substance occurs in normal urine in the form of oxalurate of ammonium.

Succinic Acid.—According to Salkowski this substance does not occur in human urine; other observers have found it following the ingestion of various articles of diet, especially asparagus. Neubauer suggests that inasmuch as wine and other fermented drinks contain not inconsiderable quantities of this acid and the latter, at least in part, goes over into the urine unchanged, we have a really frequent source for its occurrence in normal urine.

Carbolic Acid.—Only a very small quantity of this acid can be separated from normal human urine; when pres-

ent in the urine in excess (without being given internally or used externally) it is indicative of the intensity of putrid fermentation in the intestine; in septic maladies, empyema with pleural fistula, tetanus, and acute tuberculous peritonitis, the amount of carbolic acid in the urine is increased. To detect or to estimate it the urine may be distilled with sulphuric acid and precipitated with bromine water. Other acids very similar to it called taurylic, damaluric and damolic, are also found in the urine.

Iron.—Iron for the most part is found only in very minute quantity in the residue of urine after ignition. If the urine contain blood, iron is more easily detected in the ash. According to Magnier the normal amount averages 0.007 gramme to the litre of urine. Quillart's method of detecting iron in the urine is to treat the residue with sulphuric acid, then, after cooling, with nitric acid, evaporate gently, dissolve in water acidulated with a drop of nitric acid and test the solution for iron with the usual reagents of this metal. Preparations of iron taken internally greatly increase the amount of iron in the urine.

Hypo-Sulphurous Acid.—This acid was found by Strumpell in the urine of a typhoid fever patient.

Ammonium Salts.—According to Woodman and Tidy the amount of ammonia on an average in the normal urine of twenty-four hours is 0.162 gramme. It diminishes one-half in acute articular rheumatism, albuminuria, phthisis and nervous diseases. It sinks to one-quarter the normal amound in erysipelas, variola, typhus and typhoid fevers. It is said to disappear almost wholly from the urine shortly before death.

Silicic Acid.—This acid occurs only in very small amount in the urine.

Nitrates and Nitrites.—According to Schoenbein, every normal urine contains small amounts of nitrates coming from food and water. The nitrates are gradually reduced to nitrites by the urinary fermentation which soon takes place on standing. Hydrogen peroxide according to the same authority may be found in normal urine.

Coloring Matters.—Various coloring matters have been described as occurring in normal urine, such as urobilin, urochrom, uroxanthin, uroglaucin and urrhodin, and uroerythin.

Among the *abnormal* constituents found occasionally in the urine we may mention fibrin, casein, albuminose paralbumin and paraglobulin, peptone and nephrozymase, among the substances related to albumin; among those related to sugar, alkapton and inosite; miscellaneous substances: biliary acids, cholesterin, lactic acid, the volatile fatty acids, benzoic acid, sulphuretted hydrogen, allantoin, alloxan, cystin, leucin, tyrosin, oxymandel acid, oxyphenic acid, uro-rubro-hæmatin and uro-fusco-hæmatin, acetone, alcohol and ethyldiacetic acid.

Fibrin.—In urine containing blood as in severe inflammation of the kidneys and urinary passages, fibrin may separate in somewhat large masses. Ackermann found it in the urine in galacturia. Isolated cases have been observed also in which fibrin separated from the urine partly as a gelatinous mass and partly as granular or fibrillated clumps. The microscope will show the regular *fibrin cylinder* rolled-up with sharp contour and yellow in color.

Paralbumin and Paraglobulin.—These substances have
urine in cases of Bright's disease; they
by diluting the urine with water

after filtration until its specific gravity becomes 1003 or 1002 and then passing carbonic acid through the dilute fluid. Sometimes the dilution with water is enough to cause a turbidity due to them, especially in case of paralbumin.

Peptone.—According to Senator peptone can be detected in every albuminous urine; Gerhardt has observed it in urine free from albumin, either as a forerunner or as a consequence of albuminuria. If the urine contain albumin remove the latter by heat, filter, add to the filtrate three times its volume of alcohol. Shake well, dissolve the precipitate which takes place—after filtering and washing with alcohol—in water and on heating with nitric acid a yellow coloration is given it.

Nephrozymase.—According to Béchamp three times its amount of 88 to 90 per cent alcohol will precipitate from every normal urine a substance capable of changing starch into sugar at 60° to 70° C.

Alkapton.—This substance was first observed by Boedecker in the urine of a man forty-four years old, who suffered repeatedly from severe cough and expectoration after typhoid fever. The urine contained not over one per cent of sugar. Fuerbringer detected it in the urine of a man twenty-nine years old troubled with lung disease. Johnson detected it on one occasion and, recently, Armstrong observed it in the urine of a child three years of age. According to Boedecker urine containing alkapton turns brown on addition of caustic potash solution, without heat, and strongly reduces a solution of copper. In the case reported by Armstrong the urine darkened on addition of caustic potash solution, but Trommer's test being applied *partial* reduction only of the copper salt took place. Alkapton does not ferment like sugar, and

although usually classified with the sugars Smith thinks it probable that it belongs to the aromatic compounds. (See Brenzcatechin).

Inosite.—Neukomn found this substance in the urine of Bright's disease and in diabetic urine. Gallois investigated the urine of 102 patients, but found inosite in only seven cases; five of these were cases of diabetes and two Bright's disease.

Lactose.—In women, milk sugar (lactose) appears in the urine from twenty-four to forty-eight hours after the weaning of children, etc.

Biliary Acids and Cholesterin.—The biliary acids have been found at times in the urine of pneumonia without the biliary coloring matters. Otherwise they are found in company with the latter. To detect biliary acids in the urine add to it a little cane sugar, then dip into it a piece of filter paper; allow the latter to dry and by means of a glass rod place a drop of pure concentrated sulphuric acid on it and in about a quarter of a minute a beautiful violet color will appear. According to Dragendorff a small quantity of biliary acids will often be found in healthy urine. Occasionally taurin is found in the urine of icterus.

Cholesterin appears to have been found in the urine of patients suffering from fatty degeneration of the kidneys. To detect it collect the sediment and dry the latter over a water-bath; next, digest in a mixture of alcohol and ether. Filter, concentrate by evaporation and upon cooling crystals of cholesterin will form in more or less profusion. Use a power of 300 or 400 diameters and very thin, rhomboidal or rectangular tables will be seen, frequently showing a break on one of the borders, and ordinarily overlapping one another.

Lactic Acid, etc.—Lactic acid is said to be more or less constantly present in the urine of those suffering from pulmonary catarrh and many febrile diseases. Lehmann found it always present in urine containing much oxalate of lime. According to Schultzen and Riess, paralactic acid occurs abundantly in the urine after phosphorus-poisoning. It has also been found in the urine in acute atrophy of the liver, trichinosis, and osteomalacia. There are no characteristic tests for lactic acid; it is identified by the microscopic appearance of some of its salts.

Volatile Fatty Acids.—Formic acid occurs in the urine, according to Buliginsky and Thudichum; acetic acid appears in the urine as soon as it has begun to ferment; propionic acid occurs in fermenting diabetic urine, and, according to Salkowski in normal urine; butyric acid is rarely found in normal urine, more frequently in abnormal, being, it is supposed, one of the results of the metamorphosis of leucin; baldrianic or valerianic acid has been found in the urine of typhoid fever, variola, and acute atrophy of the liver.

Benzoic Acid.—In putrefying urine benzoic acid may be found, due to the decomposition of hippuric acid. Hilger found it in the urine after partaking largely of asparagus.

Sulphuretted Hydrogen.—This substance is only found in the urine in rare cases, as in violent cystitis from decay of albuminous urine in the bladder; when the urine contains it the smell of rotten eggs is at once noticed. Such urine blackens paper moistened with sugar of lead solution.

Allantoin.—Schottin found allantoin in the urine after large amounts of tannic acid had been taken.

Alloxan.—According to G. Lang this substance has

been met with in the urine of a patient suffering from heart disease.

Cystin.—Cystin often occurs dissolved in the urine and may be precipitated with acetic acid. It also occurs as a sediment mixed with urate of sodium; as a calculus its occurrence is rare. Not unfrequently, however, large concretions of almost chemically pure cystin are passed with urines containing cystin as a sediment. The little stones of yellow color and crystalline structure vary from the size of the head of a pin to that of a pea. Urine containing cystin is generally paler than healthy urine, frequently of an oily appearance, with occasionally a greenish tint and usually of low specific gravity. Its odor is similar to that of sweet briar, but on decomposing it exhales sulphuretted hydrogen and some little ammonia. It forms white or pale fawn-colored amorphous deposits; under the microscope it is seen as colorless, transparent, six-sided plates or prisms, resembling the hexagonal plates of uric acid. They are, however, soluble in ammonia. To test a deposit for cystin, treat it with acetic acid and boil, by which means urates and phosphates will be dissolved; let the sediment which is left undissolved settle, decant the urine and add to the sediment nitric acid. Heat, and the sediment, if cystin, dissolves leaving a reddish-brown mass on evaporation. If the microscope has shown us hexagonal plates or square prisms as well, we are able to identify cystin. Its clinical significance is unknown save its liability to cause formation of calculus.

Leucin and Tyrosin.—These substances have been found in the urine in cases of acute yellow atrophy of the liver, phosphorus-poisoning, small-pox and various exanthemata; their presence, nevertheless, is not confined to

the urine of these diseases, as they have been noticed in the urine of some nineteen others. In lighter cases leucin alone may be present but the appearance of tyrosin is deemed significant of grave conditions. Under the microscope leucin appears in the form of spheres which, if the illumination be sufficient, will exhibit radiating and concentric striæ; tyrosin shows very fine, long, delicate, silky, acicular prisms, arranged in bundles, tufts, or sheaf-like collections, often crossing each other, or forming spiculated balls. Tyrosin crystals are often colored yellow by presence of bile pigments.

Oxymandel Acid.—This substance, supposed to spring from tyrosin, has been found in the urine in cases of acute yellow atrophy of the liver, together with leucin, tyrosin, and paralactic acid. A new aromatic acid was obtained by Schultzen and Riess in the urine of phosphorus-poisoning; the material was not sufficient for accurate investigation.

Oxyphenic Acid (Brenzcatechin).—This substance was found in the urine of a male child, four months old, by Ebstein and Mueller; on addition of caustic potash solution the urine darkened, especially on shaking; an alkaline solution of copper was reduced on heating. It is possible, therefore, from these and other reasons, that Boedecker's "alkapton" was this substance.

Uro-rubro-hæmatin and Uro-fusco-hæmatin. — Baumstark found these pathological coloring matters in the urine of a patient afflicted with leprosy. The quantity of the two pigments amounted in twelve days to about two grammes. The color of the urine was at first a deep, dark red like Bordeaux wine, gradually becoming brown-red and toward death a pure dark brown, almost black.

Acetone, Alcohol, and Ethyldiacetic acid.—The chloro-

form odor of many diabetic urines is said to be due to the *acetone* which they contain; such urines are colored dark reddish-brown with iron chloride. (Kussmaul affirmed that diabetic coma was due to acetone in the blood; but in several cases competent observers have found none, and in others, only faint traces.) The substance in the urine of diabetics which gives a red coloration with ferric chloride, resembles in this respect acetic ether; it also breaks up into acetone and alcohol. Nevertheless, Quincke has shown that urine giving this reaction with ferric chloride does not smell of acetic ether, nor can the latter be extracted from the urine by shaking with ether, and, if in combination, is neither with acids, alkalies or normal constituents.

Deichmueller failed to obtain any alcohol from forty litres of diabetic urine, but found from .093 to .147 per cent of acetone. He concludes that the substance giving the red coloration with ferric chloride, is free diacetic acid. Tollens confirms this, and adds that when such diabetic urine is shaken with ether there is only a trace of the ferric chloride reaction with the ether extract; but when a solution of ethyl-aceto-acetate was added to the urine in proper proportions, the latter was readily extracted by ether.

RESULTS OF RECENT ANALYSES.

One hundred specimens of urine recently sent from Chicago and various localities in Illinois, Wisconsin, Iowa, Michigan and Missouri, yielded, on analysis by the author, the following results:

Total number of specimens, - - - - -	100
Containing Albumin, - - - - - -	24
" Sugar, - - - - - - -	10

Containing Biliary matters, - - -	2
" A noticeable sediment, -	84
Normal, or nearly so, - - - - - -	10

Under the head of Albumin and Sugar are counted only such specimens as contained an *appreciable amount* of those constituents.

Albumin.—Out of the twenty-four specimens in which *albumin* was found, six were from patients suffering from well-recognized Bright's disease; three specimens contained albumin due to the presence of pus alone; two specimens contained albumin, due to blood alone The remaining specimens, thirteen in number, were, in nine cases, from patients suffering from acute febrile disorders, including pulmonary and cardiac troubles, and, in four cases, from those whose maladies—as far as the author could ascertain—were not definitely diagnosed.

The highest specific gravity of any specimen of urine containing albumin, was 1035; the lowest, 1005.

Sugar.—Of the ten specimens of urine containing *sugar* eight were from patients having diabetes mellitus; the remainder, two in number, were from persons whose subsequent history could not be ascertained.

Highest specific gravity of any specimen containing sugar, 1044; lowest, 1030.

Sediments.—The constituents of the sediments in the eighty-four specimens which contained them in plainly visible amount, were various: *Uric acid, urates*, or both together, were found in twenty-eight specimens; *phosphates* were detected in plentiful amount in seventeen; *oxalate of calcium* crystals were seen with the microscope in abundance in ten; *blood* was found in six; *pus* in eight; *tube-casts* in ten; excess of mucus, epithelia, etc., in a large number; it will be seen, therefore, that one

specimen of urine would often furnish a variety of different constituents in its sediment.

It will be noticed that the most common deposit in these cases was that of *urates;* this, I believe, is the case in general.

It is said in some text-books that next to urates *oxalate of lime* is the most common urinary sediment; I have not found this to be the case in specimens of urine I have seen thus far, the phosphatic sediment being more abundant than the oxalate, not only in the cases recorded here, but in many others which have come under my observation.

Of the seventeen specimens containing sediments of phosphates, ammonio-magnesian phosphate was found in the freshly-voided urine of four patients.

Remarks on the Specific Gravity of a Number of the Specimens.

The specific gravity of seventy-one of the most interesting specimens being taken, showed that thirty-seven of them were 1030 or upward; nine were either 1025 or between 1025 and 1030; fifteen were either 1020 or between 1020 and 1025; three were 1015 or between 1015 and 1020; six were 1010 or between 1010 and 1015; two were below 1010, namely, 1007 and 1005.

In other words, sixty-one out of the seventy-one were above 1020.

Although the high specific gravity found in these cases could be accounted for largely from the nature of the complaints from which the patients were suffering, nevertheless, comparatively few specimens of twenty-four hours *normal* urine less than 1020 have come under the author's observation in this western climate. As to whether the normal range is really 1020 to 1030 in this

section of the country, or whether the prevalence of "malarial" fevers, or other conditions, is responsible for it, is a question.

Of the nine specimens below 1020 in specific gravity seven contained *albumin* not due to pus or blood; in *four* of the patients Bright's disease was the trouble, as to the other three the exact diagnosis has not been made with certainty. Of the four patients known positively to have Bright's disease, two have died, namely, those the specific gravity of whose twenty-four hours urine was 1007 and 1010 respectively, at the time when examined by the author.

GLOSSARY.

Albuminuria.—Voiding of urine containing albumin; this term is used by some authors to mean Bright's disease.

Albuminoid Substances.—Those resembling albumin, as mucin, fibrin, etc. Protein substances.

Baruria.—The passing of urine containing increased amount of solid matters only.

Bilharzia Hæmatobia.—Name of a parisite sometimes found in the intestines, bladder, etc., of persons living in certain hot climates.

"Brick-Dust" Sediments.—Those containing in large part uric acid or urates.

Calculus.—Stone in the bladder. *Calculi*, plural of calculus.

Chyluria.—Voiding of urine containing chyle.

Diuresis.—Profuse discharge of urine.

Diuretics.—Substances increasing the flow of urine.

"Dry" Tests for Albumin, Etc.—Those in which the chemicals used are in the solid form.

Dysuria.—Painful, difficult voiding of the urine.

Ecchinococcus Hominis.—Hydatids sometimes found in the urine from cysts formed in kidneys or vicinity of urinary apparatus.

Enuresis.—Incontinence of urine.

Extractive Matters.—Imperfectly defined substances pre-existing in the blood and occasionally found in the urine.

Fermentation.—Decomposition of urine; two kinds are recognized, namely, acid and alkaline.

Glycosuria.—Voiding of urine containing sugar; the term is sometimes used by authors to mean diabetes mellitus.

Glucose.—Sugar of grapes, etc; used to mean the sugar found in urine.

Gravel.—Minute calculi.

Hydruria.—Voiding of urine containing increased quantity of water only.

Kiestein.—Name given to a "scum on the surface of urine during its putrefaction." Thought at one time to be of diagnostic significance in pregnancy.

Lateritious.—An adjective used to describe "brick-dust" sediments and urine containing them. Thus, a lateritious sediment is a sediment looking like "brick-dust." Lateritious urine is that containing a "brick-dust" sediment.

Leucocytes.—General term for white blood corpuscles, mucus or pus corpuscles.

Lithic Acid and Lithates.—Old terms for uric acid and urates.

Lithæmia.—State of the system when uric acid is eliminated in excess but usually with a diminution of the

other urinary constituents; the term is also used in general to describe a condition when uric acid is in excess in the urine.

Lithuria.—Voiding of urine containing increased uric acid.

Melanin.—Black pigmentary matter.

Mucin.—The principal organic constituent of mucus.

Mulberry Calculus.—One composed of oxalate of lime.

Oxaluria.—Voiding of urine depositing oxalate of lime.

Polyuria.—Voiding of urine containing increased water and solids.

Xanthuria.—Voiding of urine depositing xanthin.

"DRY" TESTS.

The use of dry tests for urinary constituents is to be recommended on the score of convenience and neatness.

The test for *albumin* already mentioned—that of trichloracetic acid, used by Raabe—is very simple in its application. The acid is sold in the form of crystals; drop one of these crystals into a test tube half full of the suspected urine and the test is performed—a cloudy zone forming (as the crystal dissolves in the urine) if albumin be present.

The essential constituents of Fehling's or Pavy's solutions may be prepared in the dry form* and *sugar* tested for, in a manner almost as simple as the test above; moreover, when the substances used in testing for sugar are kept in the dry form and used only when needed, there is none of that deterioration which Fehling's solution itself is liable to undergo.

* Dr. Pavy, of England, suggested the use of pellets.

Messrs Gross & Delbridge, of Chicago, prepare the trichloracetic acid, sulphate of copper, tartrate of potash, etc., for use in the dry tests for albumin and sugar in the manner recommended by Raabe and Pavy respectively; the materials inclosed in vials are sold in a neat case containing also several test tubes.

To perform the test for sugar or tablets, proceed as follows: Take *one* cone of caustic potash and *two* tablets of neutral tartrate of potash and dissolve them in *one* drachm of water; next take *one* tablet of copper sulphate and dissolve in *one-half* a drachm of water. Mix the two solutions, add them to one-half an *ounce* of urine and boil. The characteristic reddish-yellow precipitate will appear if sugar be present.

FORM OF RECORDING URINARY ANALYSIS.

(To be printed on letter paper.)

EXAMINATION OF URINE.

For....., at request of

Dr.....

PHYSICAL CHARACTERISTICS.

Total quantity in twenty-four hours,

Color and Appearance,

Odor,

Reaction,

Specific Gravity,

CONSTITUENTS.

Albumin,

Bile,

Sugar,

Normal Constituents.

DEPOSIT.

Quantity and Appearance,

Chemical Constituents,

Microscopical Constituents.

CLINICAL REMARKS, ETC.

(Signed),.....M.D.

INDEX.

INDEX.

PREFACE 3
INTRODUCTION 5
METRIC SYSTEM 23

PART I.
Practical Urinalysis 24

PART II.
Clinical Significance 81

APPENDIX.
Calculi 169
Effect of Reagents 172
Changes on Standing 173
What to Look for in Urine of Disease 173
Micro-Chemical Summaries 178, 179
Rare Constituents 181
Results of Analysis 189
Glossary 192
"Dry" Tests 194
Form of Recording Urinary Analysis 19

Abnormal Constituents 33
Urine ..... 93 to 110
Acetic Acid 12, 33, 186
Acetone 188
Acid Fermentation 106
Acid Phosphate of Sodium
amount in normal urine 81
Acids 12, 13
Accidental Coloring Matters 102
Acute Yellow Atrophy of Liver 115, 125
what to look for in 174
Addison's Disease, urea in 115
Adjustment 18
Air-Bubbles
to remove from urine 27
in urine of albuminuria 105
containing bile 105
containing sugar 105
Albumin, tests for ..... 33 to 35
significance of ..... 41, 129 to 138
and sugar together 40, 42
"normal" 129
transitory 130
diet, etc., affecting 130
diseases in which found 130
drugs affecting 131
Albuminuria
in diphtheria 132
in pregnancy 132
in Bright's disease 132 133
what to look for in 173
Alcohol 12, 188
Alkalies 13
Alkaline Fermentation 106
Alkalinity of the Urine
significance of 32, 106–109
artificial production of 107
produced by diseases 107–108
due to fixed alkali 108
to volatile alkali 109
cautions in regard to 109
contents of 108
Alkapton 184
Allantoin 186
Alloxan 186
Allen's Sugar Test 38
Aloes 103
Ammonia 12, 18, 109, 182
Ammonium Carbonate 108
molybdate 12
Ammonium urate 147, 170
Ammoniacal Urine 106, 109, 116
Ammonium Salts 182
Ammonio-Magnesian (or triple
phosphate) 144
microscopic appearance of 48, 49
as Calculi 80, 171
significance of 144
Amyloid Degeneration, 73, 95, 97, 158
casts 65
Anæmia 31, 79, 107
Analysis by Author 189
Aniline 97, 103
Antidotes 14
Apparatus
chemical 1–12
microscopical 15–17
Appearance of the Urine 25

significance of..... 31
Asparagus.....106, 148
Arthritis.....123, 175, 177
Ascites.....31, 32, 98, 100, 101, 116
Asthma..... 114
Author's Analyses..... 189
observations on quantity of urine in twenty-four hours..... 82
Average composition of normal urine..... 81
Average number of urinations daily 90
Average of quantity voided at each urination..... 90
Average quantity urina sanguinis... 90
Bacteria.....71, 74, 167
Baldrianic Acid..... 186
Barium Chloride.....12, 77, 172
Benzoic Acid..... 186
Biliary Acids..... .....142, 185
Bile.....41, 42, 142, 174
Bird's Tables..... 28
Bladder Affections (see Cystitis).
Blood.....159–163
clinical significance.....71, 159–163
tests..... 52
microscopic appearance.....53–56
coloring matters..... 71
diseases in which found in urine 160
Blood extractives..... 35
Blue Urine..... 104
Boil, how to.....6, 35
Bone Diseases.....122, 123, 124, 152
what to look for in..... 176
Brenzcatechin.....184, 188
Bright's Disease
quantity of urine in, 31, 95, 97, 133 to 138
albumin in..... 41
blood in.. 71
casts in..... 73
urea in.....79, 115
specific gravity of urine in..... 98
sulphates in..... 121
phosphates in..... 122
"diagnosed" from urate sediments..... 145
mucus in..... 155
Bumping, prevention of..... 37
Burns, Effect of on Urine.....103, 123
Butyric Acid..... 186
Calcium
oxalate..... 148
phosphate..... 144
Calculi..... 51
examination of.....79, 169–172
uric acid.....80, 170
phosphatic.....80, 170
oxalate.....80, 170
carbonate of lime..... 80
Calculation
of specific gravity... 28
of solids..... 29
Camel's hair pencil..... 71
Campeachy wood..... 103
Cancer..... .....79, 123, 125
Cancer cells..... 166
Carbolic Acid..... 181
Care of microscope.....18–20
Carmine solutions..... 21
Caries..... 123
Casts
amyloid..... 65
blood..... 63
classification..... 157
clinical significance.....73, 156
collection and examination..... 63
epithelial..... 63
fatty or oil..... 63
fibrinous..... 63
granular..... 63
hyaline, waxy 64
mucus..... 66
origin of..... 156
white cell..... 158
of seminal tubules..... 67
how to identify..... 67
cautions..... 67
diseases in which found..... 156
in Bright's disease..... 157
Cells..... 15
Cerebral troubles.....121, 123, 141
Cerebro-spinal diseases.....96, 123
Cerevisiae (see Torula).
Chemical terms..... 12
Chemicals, use of..... 12
Chlorides
amount of in normal urine..... 81
chlorinated soda..... 12
chlorine 18
significance of sodium chloride... 119
Chlorosis.....31, 79, 107, 114
what to look for in..... 175
Cholestearin as calculi.....169, 185
Cholera
quantity of urine in 96
urea in..... 114
chlorides in..... 119
phosphates in..... 122
Changes in normal urine on standing..... 173
Chylous urine.... - 49, 52, 105, 151
Circumstances
increasing quantity of urine..... 85
decreasing " " " 85
increasing solids in urine..... 91
decreasing " " " 91
affecting color of urine..... 105
Clinical cases, urine in.....99, 100
Clinical Summaries
physical characteristics..... 31
abnormal constituents..... 41
non-organized deposits..... 50
organized deposits..... 71
normal constituents..... 79
Clinical significance of urine.....81–167
Cirrhosis of liver.....31, 97, 125
Cold, exposure to..... 159
Collection of sediment.....8, 10
Coloring matters..... 183
amount of in normal urine..... 81
significance of..... 127
Convalescence..... 31
Cover
glasses..... 17
pasteboard..... 17
Color of urate sediments..... 146

Color of the urine.....25, 31, 101–104
abnormal..... 31
accidental..... 31
normal.....25, 31
significance of.....31, 101–104
colorless urine..... 101
high-colored..... 102
blood-red..... 102
dark brown..... 102
green..... 102
dirty-blue..... 102
smoky..... 102
white.....102, 105
black..... 102
pale..... 102
milky..... 102
Composition of the urine..... 81
Condensed yeast..... 12
Consistency of the urine..... 105
Convulsions..... 31
Creatin and Creatinin
amount in normal urine.....81, 128
significance of.....128, 181
Copaiva..... 34
Cubebs..... 34
Cystin
as calculi..... 187
clinical significance..... 187
general appearance of deposit..... 187
microscopic appearance..... 187
tests for..... 187
Cystitis
odor of urine in..... 106
reaction of urine in..... 108
false albuminuria in..... 133
Damaluric Acid..... 182
Damolic Acid..... 182
Debility..... 107
Declat Method..... 121
Decreased Quantity of Urine.....31, 96
Deposits
apparatus for collection of.....8, 10, 18
classifications.....42, 142
due to natural causes.....144, 145, 148
examination of.....18, 21, 22
micro-chemical analysis.....178, 179
non-organized.....43, 143, 178
organized.....52, 143 179
phosphatic.....143, 144
urate..... 145
uric acid..... 147
oxalate..... 150
Diabetes.....31, 79, 95, 99, 124
insipidus..... 95
what to look for in..... 174
mellitus.....95, 139
what to look for in..... 176
quantity of urine in..... 94
specific gravity in..... 99
odor..... 106
urea in.....112, 114
phosphates in..... 123
Diabetic Food..... 140
sugar..... 138
urine.....106, 140, 189
Diet
affecting odor of urine..... 106
" quantity..... 95
affecting urea..... 111
" chlorides..... 119
" uric acid..... 125
Differential Density
fermentation test..... 39
Diffuse Bronchial Catarrh..... 112
Diphtheria..... 41
Diseases
affecting quantity of urine, 31, 94–97
" color of urine.....31, 102
" odor of urine.....31, 106
" aspect of urine.....31, 104
" reaction of urine.....32, 107
" specific gravity..... 32
" solids..... 37
" consistency..... 105
" urea.....112, 114
" chlorides..... 119
" phosphates..... 122
" uric acid..... 125
causing presence of albumin..... 130
" deposits, 144, 145, 147, 149, 153, 155, 156, 160, 164
Distilled water.....12, 87
Diuretics..... 97
Drop bottles..... 21
Drugs.
affecting quantity of urine..... 97
" color.....102–104
" odor..... 106
" reaction..... 107
" solids..... 109
" fluid..... 110
" urea..... 112
" chlorides..... 119
" phosphates..... 122
" hippuric acid..... 128
" uric acid..... 125
" albumin..... 131
" deposits.....143, 149
" presence of fat..... 151
" " of casts..... 156
causing oil in the urine..... 152
"Dry" Tests.....192, 194
Dyspepsia.....107, 147
Dysuria..... 193
Effects of Reagents on Normal Urine..... 172
Enteric Troubles.....107, 123
Epithelium.
recognition of.....60, 155
significance of.....72, 155
diseases in which abundant..... 155
Extractive Matters..... 42
Extraneous Substances..... 67
Eye-glass..... 15
diseases..... 124
Estimations.
quantity of albumen..... 34
" " sugar..... 39
" " urea.....75, 116
" " chlorides..... 76
" " phosphates..... 77
" " uric acid..... 126
" " coloring matter..... 128
Exacerbations.
febrile..... 146
Exanthemata, urea in..... 112

Experiments of Author..... 82
Fat.
detection of..... 49
significance of.....51, 151
Form for Recording Urinary Examinations 196
Formic Acid..... 186
Froth on Urine..... 105
Fungi.
microscopical appearance of..... 69
significance.....73, 167
Fehling's Solution..... 12
Fevers, etc.....31, 79
quantity of urine in..... 96
specific gravity of urine in..... 99
solids in..... 101
cerebro-spinal..... 96
intermittent.....96, 113, 120
typhoid..... 113
typhus.....71, 73, 96, 113
yellow.....96, 114
what to look for in..... 174
Filtration 9
Fibrinuria.....105, 183
Glass.
covers..... 17
jars..... 11
rods..... 11
slides..... 15
Glossary 192
Glycosuria.....138, 141
Gonorrhœa.....72, 153
Gout.
atonic..... 31
urea in..... 114
phosphates in..... 123
uric acid in..... 148
what to look for in..... 177
Gramme 23
Gravel..... 51
Guaiac 52
Hæmaturia..... 159
Haemoglobinuria..... 158
Haines' Sugar Test..... 36
Heat, how to..... 6
Highly Colored Urine..... 31
Hints to Diagnosis
of Bright's disease..... 138
of uric acid calculus..... 148
from blood in the urine.....160–163
from pus " " 164
from spermatozoa..... 165
of calculi..... 171
Hippuric Acid..... 128
Hydrochloric Acid.....12, 13, 18
Hydrogen Peroxide..... 183
Hydruria..... 94
Hysteria..... 31
temporary increase of urine in.... 95
what to look for in..... 176
Hypobromite Process for Urea..... 116
Hypoxanthin..... 181
Hyposulphurous acid..... 182
Irritation..... 153
Iron 182
Indican
test for..... 78
significance..... 79
Icterus
what to look for in..... 174
Infants' urine
odor of..... 93
Inflammation
with exudation.....79, 119
urea in..... 112
chlorides..... 119
phosphates..... 122
what to look for in..... 174
Infusoria (See Fungi).
Increased Quantity of Urine.....31, 94
Increased Tension..... 95
Inorganic Constituents of the Urine 81
Inosite..... 185
Intermittents
what to look for in..... 177
quantity of urine in..... 96
urea in..... 113
chlorides in 120
phosphates in 123
Interstitial Nephritis
quantity of urine in..... 95
Lactic Acid 186
Lactose..... 185
Lardaceous Degeneration..... 158
Lens..... 15
Leucin..... 187
Leucorrhœa.....72, 155
Leukaemia. 177
Linen, old.....17, 19
Lithæmia 125
Litmus Paper..... 11
Litre..... 23
Liver, Diseases of
reaction of urine in..... 107
acute yellow atrophy of.....115, 125
cirrhosis.....31, 97, 125
cancer..... 125
oxaluria in..... 149
uric acid in..... 146
what to look for in..... 177
Lung Diseases
what to look for in..... 175
Metric System..... 23
Micro-Chemical Examinations, 178, 179
reagents..... 21
summary.....178, 179
Microscope..... 15
Magnesium
ammonio-phosphate..... 144
Magnifying Powers..... 15
Masturbation..... 73
Meals
effect on urine.....91, 93
Meningitis..... 123
what to look for in..... 175
Menstruation..... 71
Mirror..... 18
Mollities Ossium 123
Mould Fungus..... 167
Movement 18
Mucin..... 60
Mucus
recognition of..... 59
tests for.....59, 153
microscopical appearance of, 59, 153
significance of.....72, 153

amount of normal urine..... 81
differentiation from pus..... 153
diseases in which abundant..... 153
Nephritis
interstitial..... 95
scarlatinal..... 96
acute parenchymatous..... 97
chronic " 97
glomerulo-nephritis..... 158
Nephro-zymase..... 184
Nervous diseases..... 79
urea in.....112, 114
phosphates.....122, 123
what to look for in..... 176
Nitric Acid.....11, 13, 18 183
Nitrogen.....114, 118
Nitrogenous food.....111, 114, 125
equilibrium..... 126
Nitrous Acid..... 183
Normal Constituents 74
tests for urea..... 74
" " chlorides..... 76
" " phosphates..... 77
" " sulphates..... 77
" " urates..... 78
" " coloring matters..... 78
" " mucus..... 78
" " creatinin and hippuric acid..... 79
clinical significance of.....110–129
Normal Urine.....81–93
Nubecula..... 92
Number of Urinations Daily.....86–90
Objective..... 15
Odor of Urine..... 26
how modified..... 106
significance of.....31, 106
Oil in Urine..... 152
Organic Constituents of Urine..... 81
Ovarian Tumor..... 114
Oxalate of Lime
clinical significance of.....51, 148
general appearance of deposit... 45
microscopical appearance of..... 47
deposit due to physiological causes..... 148
deposit due to pathological causes 149
Oxalic Acid..... 148
Oxaluria.....51, 149
Oxaluric Acid..... 181
Oxymandel Acid..... 188
Oxyphenic Acid..... 188
Pale Urine..... 31
Paralbumin and Paraglobulin..... 183
Paralysis..... 114, 144
Penicillium Glaucum.....70, 167
Peptone..... 184
Peritonitis
what to look for in..... 175
Phosphates
clinical significance of, 51, 79, 122–124
tests for the..... 47
amount of, in normal urine..... 81
deposits of..... 144
Phosphate of Lime, amorphous 47, ...123, 144
crystalline..... 144
microscopic appearances..... 48
Phosphaturia..... 124
Phthisis.....79, 107
Polyuria..... 94
Physical Characteristics of the Urine.....24–32, 93–110
Pigments of the Urine
affinity for uric acid..... 44
and urate sediments..... 44
Pipettes..... 8
Potassa..... 12
Pneumonia.....79, 113, 120, 107, 123
Poisoning, Effect of on Urine
by mineral salts.....97, 131, 159
potassium chlorate.....97, 103
pyrogallic acid.....97, 103
aniline compounds 97, 103
atropine..... 97
phosporus 151, 97, 113, 159, 121, ...122, 131, 142
cantharides..... 97
arsenic..... 97
carbolic acid.....97, 103, 121, 131, 151
ergot 97
iodine.....97, 131
mercury..... 97
opium 97
chronic lead.....97, 101, 104, 159
duboisin 103
arseniuretted hydrogen.....131, 159
carbon protoxide.....131, 151
" dioxide.....131, 159
potassium iodide..... 131
turpentine..... 152
hydrocyanic acid..... 159
Potassium
caustic potash..... 12
ferro-cyanide 12
Powers..... 16
Precipitate..... 14
Practical Urinalysis 23–80
Pregnancy 41
Progressive Muscular Atrophy 120, ...121, 123
Pus in the Urine..... 56
occurrence and recognition of..... 56
clinical significance of.....71, 164
microscopical appearances of..... 58
effect on consistency of the urine 105
diseases in which found..... 164
Pyaemia..... 114
Pyuria..... 164
Pyorrhoea..... 73
Quantity of the Urine.....24, 31, 81–86
modified by cutaneous exhalations 85
" " diseases.....93–97
" " drink..... 85
" " food..... 85
" " pulm'ary exhalations 85
" " sex and age..... 85
" " sleep..... 85
" " stools..... 97
significance of..... 31
in Bright's disease.....31, 94, 95, 97
diabetes
Quantity of Urine Passed at Different Periods..... 86
Quantity of Urea..... 111
chlorides..... 119

Reaction of the Urine..... 26
modified by diseases..... 107
" " food..... 32
" " medicines..... 107
" " standing..... 107
significance of.....32, 107–110
tests for..... 26
Reagents
chemical.....11–12
microscopical..... 21
Rachitis..... 122
Rheumatism
quantity of urine in.....94, 96, 120
what to look for in.....175, 177
Sodium
chlorinated soda..... 12
chloride.....76, 79, 119
Solids.....29–31
amount in normal urine..... 81
how to calculate.....30, 91
significance of..... 100
Specific Gravity.....26–29
significance of.....32, 98
Spermatorrhœa..... 73
Spermatozoa
microscopical appearance of..... 68
significance of.....73, 165
Spirits Turpentine..... 12
Spinal Diseases
blue urine in..... 104
what to look for in..... 176
Salts..... 14
effect of on urine..... 97
Sandal Wood..... 34
Sediment (See Deposit).
Sarcinae.....70, 73
Silicic Acid..... 182
Silver Nitrate..... 12
Scarlet Fever..... 107
Scurvy.....71, 125, 177
Skin Diseases
sugar in..... 147
what to look for in..... 177
Stage..... 15
Stains..... 13
Succinic Acid..... 181
Sugar, in the Urine
tests for.....35, 09
" " quantity..... 39
significance of.....41, 138, 141
diet causing..... 138
diseases where found..... 138
drugs affecting..... 139
Sugar and Albumin
alternating with uric acid..... 147
in skin diseases..... 147
together..... 40
significance of.....42, 141
Sulphuric Acid.....12, 13
clinical significance of..... 121
Sulphates
test for..... 77
significance of..... 79
amount of in normal urine..... 81
Sulphuretted Hydrogen.....18, 186
Syphilis..... 123
Tests for
abnormal substances.....33 to 41
albumin.....
alkaline phosphates..... 77
amorphous urates..... 43
bile acids..... 185
bile pigments..... 41
blood..... 52
blood coloring matters..... 159
coloring matters..... 78
chlorides..... 76
chyle..... 49
creatinin..... 79
cystin..... 187
deficiency of urea..... 74
earthy phosphates..... 77
excess of urea..... 74
leucin..... 188
mucus.....59, 78, 153
oxalate of lime..... 46
pus..... 50
sugar.....35, 39
sulphates..... 77
tyrosin..... 188
urates..... 78
urea..... 75
uric acid..... 44
Test Glasses..... 7
Test-Tubes..... 5
tube rack..... 5
" brush..... 5
Torula Cerevisiae.....70, 167
Transparence of Urine..... 106
Trapp's Coefficient..... 91
Trichloracetic Acid..... 12
Turpentine.....12, 34
Typhus.....71, 73
quantity of urine in..... 96
blue urine in..... 104
reaction in..... 107
hemoglobinuria in..... 159
Tyrosin..... 187
Urates
significance of.....79, 124
amorphous..... 140
amorphous, test for..... 43
crystalline..... 146
precipitated by acid fermentation 50
by cold..... 50
by pathological conditions, 50, 51, 125, 145
by physiological conditions, 50, 145
microscopical appearances of...43, 44
amount of in normal urine..... 81
deposits..... 145
color of..... 146
Urate of Ammonium..... 124
of calcium..... 124
of magnesium..... 124
of potassium..... 124
of sodium.....43, 124
Uraemia.....100, 111
Urea
decomposition of..... 108
significance of.....79, 112, 115
modified by diet..... 111
" " disease..... 112
nitrate of..... 74
quantitative test for.....75, 116
test for deficiency of..... 74

test for excess of..... 74
amount in normal urine..... 81
tables of Harley..... 111
influence of age upon..... 111
excretion of..... 111
Uterine Diseases
cancer..... 114
Uric Acid
clinical significance of.....50, 125
colored by pigments..... 45
common forms of..... 45
general appearance of deposit.... 44
microscopical appearance of.....44, 46
test for..... 44
rare forms of..... 46
solubility of..... 44
amount of free in normal urine... 81
calculi.....80, 170
deposits of..... 147
estimation of..... 126
Urina Cibi 86
potus.....31, 86
sanguinis. 86
Urohaematin
test for..... 78
significance 79
Uro-rubro-haematin 188
Uro-fusco-haematin..... 188
Urine
acidity of.....26, 107
acid fermentation..... 106
alkalinity.....26, 108
apparatus for collecting..... 134
pale..... 102
black..... 102
blue.....102, 104
quantity of normal.....82 to 90
color of normal.....81, 92
consistency of normal.....92, 104
reaction of normal..... 93
extraneous substances in..... 67
specific gravity of normal..... 91
fluorescence of normal..... 92
glass for deposits..... 6
turbidity 104
green.....102, 103
odor of normal..... 93
opacity of..... 104
when to examine..... 25
solids in normal..... 91
transparence of normal..... 92
transparence of abnormal..... 104
of infants 93
Vibriones.....71, 74
Valerianic Acid..... 186
Volatile Fatty Acid..... 186
Water, distilled.....12, 17
amount in urine..... 81
What to Look for in Urine of Disease..... 173
Window Suitable for Microscopic Work..... 17
Xanthin..... 181
Yeast
condensed 12, 13
fungus 167
Yvon's Process for Urea..... 116

DESCRIPTIVE CATALOGUE

OF

GROSS & DELBRIDGE'S

HOMŒOPATHIC

MEDICAL BOOKS.

For Sale at all Homœopathic Pharmacies or sent prepaid on receipt of Price.

CHICAGO:
GROSS & DELBRIDGE,
1882.

The Science and Art of Obstetrics. By SHELDON LEAVITT, M. D., Prof. of Obstetrics and Clinical Midwifery in Hahnemann Medical College and Hospital, Chicago; author of "The Therapeutics of Obstetrics," etc. 658 pages, royal octavo. Price, cloth, $6.00; sheep, $7.00. 265 illustrations.

This work is intended to fill the want so long felt by Homœopathic teachers of Obstetrics, students, and practitioners, of a text book which should deal with the subject as both a science and art, and embody the researches and improvements which have been made in this branch of medicine during the past few years. The work has been carefully prepared, and sets in the foreground no theories or empty chimeras in respect to etiology, pathology, diagnosis, or treatment, but accepted ideas, and rational deductions from extensive observations and experience.

"We are in receipt of advance sheets, covering nearly one-half the text of this forthcoming book, which promises to be a text book *par excellence*, as the matter appears to be concisely prepared and quite free from the theory and quotation which so often form the bulk of similar works. In other words, we may say that it is the *vade mecum* of the department which it represents, and compares favorably with a similar work prepared by Prof. T. G. Thomas, for the use of his students.

A marked feature of the book is its divisions and sub-divisions, by means of which the student will the more readily grasp and complete the study of each particular subject before entering upon another. This we consider an important point in a book of this character.

The illustrations embrace some two hundred and fifty figures of excellent design and execution; many of them are original, and some are drawn from life. These drawings are of inestimable value to the stndent of midwifery.

The aim of the author has evidently been to present a clear, dignified and creditable treatise on the subject, and as far as we have examined, all important points seem to have been touched upon and the practical ones sufficiently elaborated.

The physical part of the work, so far as we can judge, will be faultless, as might be expected, the name of the publishers being sufficient guarantee in this particular.

This work must certainly become *the* text-book of our colleges, and it will be found an excellent hand-book for the busy practitioner, because every important point of obstetric practice is so clearly stated, and from the arrangement, so readily found.

We congratulate the author on the success of his effort, the publishers on their opportunity to issue so worthy a book, and 'Our School' on possessing the ability within itself which has made such an undertaking possible."—*New York Medical Times.*

GROSS & DELBRIDGE, Publishers,
48 Madison St., CHICAGO.

A Physiological Materia Medica, containing all that is known of the Physiological Action of our Remedies, their Characteristic Indications, and their Pharmacology By W. H. BURT, M. D. Chicago : Gross & Delbridge. 1881. 992 pages. Cloth, $7, Sheep, $8. Third edition. For sale by Homœopathic Pharmacies, or sent free by the Publishers, on receipt of price.

We believe that no book on Materia Medica in our literature so completely meets the requirements of the Physician and Student as this; and, as proof of the correctness of this opinion, we have to announce the sale of the entire first edition in ninety days. Such a reception has never been awarded before to any book in Homœopathic literature The demand for the work indicates that its appearance was opportune, and that its plan and execution are approved by the Profession We have received a large number of favorable notices both from Physicians and the Press, from which we make the following selections :

Dr. Burt has brought together in a compact and well arranged form an immense amonnt of information The profession will fully appreciate the labor and skill with which the author has presented the physiological and pathological action of each drug on the organism.—*New York Medical Times.*

We are sure that Dr. Burt's new work will have deservedly a rapid sale. Gross & Delbridge are a new publishing house in the medical line ; but certainly they must be old hands in the business. for paper and printing leave nothing to be desired. May they never falter in such laudible work, and the eyes of the readers will bless them forever —*Dr. Lilienthal in North American Journal of Homœopathy.*

An enthusiastic yearning for the *whys* and *wherefores* of our wondrous Therapeutic art has brought Dr Burt to the front again among the best book-makers of our time.—*St. Louis Clinical Review.*

We can recommend the book as full of interesting and profitable reading —*Hahnemannian Monthly.*

Dr. Burt has the power of sifting the tares from the wheat.—*Chicago Medical Times.*

We cordially recommend Dr. Burt's book.—*New England Medical Gazette.*

The work is a credit to Chicago.—*Medical Investigator.*

GROSS & DELBRIDGE, Publishers,

48 Madison St., CHICAGO.

A Complete Minor Surgery. The Physician's Vade-mecum. Including a Treatise on Venereal Diseases. Just published. By E. C. FRANKLIN, M. D., Professor of Surgery in the University of Michigan. Author of "Science and Art of Surgery," etc. Illustrated with 260 wood cuts. 423 pps. Octavo. Price, cloth, $4.00. Sheep, $4.50.

This work is just such a one as might be expected from the pen of one experienced in teaching as our veteran author, and is properly designated as "complete." The text is lucidly and concisely written, the therapeutics clear and practical, and the whole is well adapted to the uses of the general practitioner. This book fills a gap which has never before been met, and we prognosticate a large demand for it.—*New York Medical Times.*

Prof. Franklin has given us a work containing some new features, and embracing a larger field than has heretofore been covered by manuals of minor surgery. The work is well illustrated and is every way a most convenient and satisfactory treatise.—*Chicago Medical Times (Eclectic.)*

This is a work containing all the general practitioner of medicine should endeavor to assimilate on the subject of surgery. For ready references and emergencies this work is not surpassed. We heartily recommend the work to the profession. The publishers have done good work in issuing the book so creditably, and the profession will appreciate the large, distinct type used, and the prominence given words so as to enable the reader to secure readily that which he is looking for.—*Cincinnati Medical Advance.*

I have been very much pleased in the perusal of Franklin's Minor Surgery, issued by your house. The book, I have no doubt, will prove useful to the busy practitioner, and add to the reputation of the learned author.—*Dr. Charles Adams.*

With this book in possession no practitioner will need any other text book on Minor Surgery. It is full and complete, and any bandage, dressing and instrument known or used is illustrated.—*Dr. Valentine in Clinical Review (St. Louis.)*

For Sale at all the Pharmacies, or sent free on receipt of price.

GROSS & DELBRIDGE, Publishers,

48 Madison St., CHICAGO.

Lectures on Clinical Medicine. By M. Le Dr. P. Jousset, Physician to the Hospital Saint-Jacques, of Paris; Professor of Pathology and Clinical Medicine; Editor of *L'Art Medical.* Translated with copious Notes and Additions by R. Ludlam, M. D., Professor of the Medical and Surgical Diseases of Women and Clinical Midwifery in the Hahnemann Medical College and Hospital of Chicago. Large 8vo. of over 500 pages, cloth, $4.50; half morocco, $5.00.

This work is one of very great interest to the profession and to students, embodying, as it does, about forty years of experience on the part of the author, and that of nearly thirty years by the translator. It sets forth the best and freshest pathological views; the most practical application of the homœopathic method of treating a disease; and a clear and forcible bed-side analysis of the cases that are presented. The author discusses, from a practical standpoint, the questions of Alternation, Attenuation, Dose and Repetition, and of Individualization and Aggravation. The subjects embraced in these lectures include Asthma, Emphysema, Rheumatic Endocarditis, Articular Rheumatism, Bronchitis, Pneumonia, Croup, Diphtheria, Typhoid Fever, Nephritis, Albuminuria, Hæmoptysis, Hæmorrhoids, Chronic Gastritis, Scrofulous Ophthalmia, Hydrarthrosis, Pelvi-Peritonitis, Vaginismus, Menorrhagia, etc.

The practitioner may here find cases analogous to puzzlers which occur in his own practice, and cannot fail to be benefited by their perusal.

"The work presents the latest pathological data, the most practical method of treating disease homœopathically, and a critical analysis of each case related. It is eminently practical and demands the use of well proved remedies."—*From the Hahnemannian Monthly, Philadelphia.*

It contains the very best and most reliable clinical experience in the practice of homœopathy of any work extant in the profession.—*A. E. Small, M. D., in the Chicago Tribune.*

I have carefully read the work and hardly know whether I admire more the plain thorough pathology and diagnosis, or the practical common sense, honest treatment set forth. * * The Notes of Dr. Ludlam are in keeping with our best American authorship.—*J. P. Dake, M. D., Nashville, Tenn.*

The book is of great value to practitioners and students of medicine.—*J. W. Dowling, M. D., Dean of the New York Homœopathic Medical College.*

I have read the work with a good deal of interest and find it to be eminently practical and of great value to the profession.—*T. G. Comstock, M. D., St. Louis, Mo.*

GROSS & DELBRIDGE, Publishers,
48 Madison Street. CHICAGO.

An Index of Comparative Therapeutics, with a pronouncing Dose-List in the genitive case,—a Homœopathic Dose-List,—Tables of Differential Diagnosis, Weights and Measures,—Memoranda concerning Clinical Thermometry, Incompatibility of Medicines, Ethics, Obstetrics, Poisons, Anæsthetics, Urinary Examinations, Homœopathic Pharmacology and Nomenclature, etc. By SAMUEL O. L. POTTER, A. M., M. D., late president of the Milwaukee Academy of Medicine, author of "The Logical Basis of the High Pottency Question," "Munchausen Microscopy, etc." Second edition. Price, cloth, $2.00; flexible morocco, tuck, $2.50.

The leading feature of this book is its comparative tabular arrangement of the therapeutics of the two great medical schools, Under each disease are placed in parallel columns the remedies recommended by the most eminent and liberal teachers in both branches of the profession. By a simple arrangement of the type used, there are shown by a glance the remedies used by both schools, as well as the remedies peculiar to each, for any given morbid condition. Over forty prominent teachers are referred to, besides occasional references to more than thirty others. In the first class are Bartholow, Ringer, Phillips, Piffard, Trousseau, and Waring of the old School; Hempel, Hughes, Hale, Ruddock and Jousset among modern homœopathic authorities.

"Dr. Potter's compilation must be the result of a large amount of pains-taking and accurate work, and will be appreciated. As an index it is very elaborate and serviceable."—*New England Medical Gazette*

"The work is really a *multum in parvo;* as an index it is exhaustive, and very often it supplies in a few words the very information that is wanted."—*British Journal of Homœopathy.*

"I am much pleased with your Index. It is strong and will find sale among old as well as new school men." *Dr. J. P. Dake, Nashville, Tenn.*

"It will furnish the busy practitioner with a summary of immense practical value."—*Dr. H. M. Paine, Albany, N. Y.*

"It will be held in high appreciation by a large class of practitioners." *Dr. C. P. Hart, Wyoming, O.*

"I like the idea very much; besides giving many valuable hints to the practical physician, it is very interesting from a theoretical point of view."—*Dr. H. C. Clapp, Boston.*

For sale at the Pharmacies, or sent free on receipt of price. Price, in cloth, $2.00; in flexible morocco, tuck, $2.50.

GROSS & DELBRIDGE, Publishers,
43 Madison St., CHICAGO.

How to Feed the Sick; or, Diet in Disease. By CHARLES GATCHELL, M. D., 2d. edition, revised and Enlarged. Price $1.00.

This work is a very practical and timely volume not only for those who are sick, but also for those who are not really well, and to whom the problem, "What shall I eat," is of vital importance. As introductory, the various forms of animal, vegetable and inorganic foods are considered and their relative merits carefully pointed out. The Chapters that follow are devoted to such practical subjects as How to feed your Patients, Diet for Dyspepsia with aids to Digestion, Diet for Constipation, Rectal Alimentation, etc.; Diet in Consumption, Diet in Diabetis, Bright's Disease, Gravel; How to nurse the Baby, How to choose a Wet Nurse, How to wean the Baby, How to feed the Baby, Diet for Chloera Infantum, Diet for Travelers, Seasickness, the Corpulent, Scrofula, Rickets, Scurvy, Chlorosis, Collapse, Rheumatism, Asthma, Heart Disease, Alcoholism, Diarrhœa, Dysentery, Cholera, Diphtheria, Gastritis, Biliousness, etc. Diet for convalescents is a valuable chapter. Then follows a long and carefully prepared list of recipes for the preparation of Beverages, Meats, Broths, Soups, Breads, Gruels, etc., etc.

MILWAUKEE, Wis.

"I consider your work on "How to Feed the Sick" to be the most practical, and therefore the most useful, work on the subject with which I am acquainted. No physician should be without it; every mother should have it. It is in use in many of the households in which I practice." C. C. OLMSTED, M. D.

"This work is plain, practical and valuable. It is really a clinical guide on diet, and one the profession will find reliable and correct."—*United States Medical Investigator.*

"Evidently much investigation, thought and carefulness have entered into the production of this work, and we believe it to be worthy a place in every household."—*The Magnet.*

* * * "We have carefully examined the work and shall cheerfully recommend it for family use. The directions as to what food and drinks, and modes of preparation are very judicious." * * * * * Resp. Yours,

Janesville, Wis. Dr. G. W. CHITTENDEN & SON.

MILWAUKEE, Wis., Sept. 8, 1880.

"Professor Gatchell's "How to Feed the Sick" is the best book on the subject for the people. It contains in 160 pages an astonishing amount of condensed information on a subject of great importance, and one but little understood. Its style is admirable, pithy and to the point. The book has no padding about it, and deserves an immense sale. SAM'L POTTER, M. D.

GROSS & DELBRIDGE Publishers,

48 Madison St., CHICAGO.

Antiseptic Medication, or Declat's Method. By NICHO. FRANCIS COOKE, M. D., LL. D. Emeritus Professor of Theory and Practice in the Hahnemann Medical College and Hospital of Chicago. 128 pp. 12 mo., cloth, 1882. Price, $1.00. Gross & Delbridge, Chicago, Publishers.

This is the first, and must continue to be for some time, the only treatise on this vitally important subject in the English language. It is plain and practical. Though written only for the physician it cannot fail to attract attention from the intelligent layman everywhere. Especially will it be welcome to the sufferers from CONSUMPTION, CANCER, PYÆMIA, NECROSIS and all forms of blood-poisoning, and MALARIA.

"For the matter of this volume Dr. Cooke confesses his large indebtedness to Dr. Declat; but the remarkable cures of tuberculosis, cancer, septicæmia, eczema, and malarial fevers recorded in the latter half of the book are strictly original. The only treatise on the subject in the language, it must inevitably fall under the eye of every intelligent physician, and the present notice may therefore be limited to a description of its contents. There consist of an introduction, which not more lucidly sets forth the teachings of Declat than it effectually demolishes the claims of his rivals, Lemaire and Lister; some remarks on antiseptics in general, giving preference to phenic acid and the protochloride of iron prepared according to Boudreaux's method; and an examination of phenic acid, both in its chemical and therapeutical aspects. Besides all this we have directions for the use of the hypodermic syringe; and last, and most interesting of all to the laity, who care little how they are cured, full accounts of a number of cases that have been successfully treated by the method of Declat. The average medical man, who is more likely to close his ears to the voice of the sage than to the song of the siren, will skim lightly over the cases of cancer, and say in his easy, superior way, that not one of them was a case of true cancer. He will certainly say this to his own patients, for whose enlightenment it may be well to mention that Dr. Cooke is an Emeritus Professor of Diagnosis. Dr. Cooke has been wonderfully fortunate in his use of the new remedy, but he has the candor to admit that he has not always been victorious "—*The Chicago Tribune*, Sept. 11th, 1882.

"'Antiseptic Medication' is a small volume by Dr. N. F Cooke, of the Hahnemann Medical College of this city, avowedly a treatise on the theory and method of Dr. Declat, a recent visitor from the old world, which have attracted a great deal of attention of late. It is pretty generally safe to suspect something of exaggeration in almost anything which takes so sudden a hold upon popular enthusiasm, but it must be said, from hastily running through Dr. Cooke's advance sheets, that he makes out a pretty strong case.

* * * * * *

The subject-matter treated of in Dr. Cooke's book belongs especially to the medical profession, and the volume can scarcely fail to be one of great interest to all of that profession not "hide-bound," as it is called, in foregone conclusions.

It is clearly the work of an earnest, thoughtful, and scientific man, even if nothing else was known of the author."—*Chicago Times*, Sept. 11th, 1882.

Sent free on receipt of price.

GROSS & DELBRIDGE, Publishers,
48 Madison St., CHICAGO.

A Compendium of Venereal Diseases, For Practitioners and Students; being a condensed description of those affections and their Homœopathic Treatment. By E. C. FRANKLIN, M. D., Professor of Surgery in the Homœopathic Department of the University of Michigan; Surgeon to the University Homœopathic Hospital; Author of "Science and Art of Surgery," "A Complete Minor Surgery," etc., etc. About 112 pages. Octavo. 1883. Price $1.25.

"This compendium of venereal diseases has been prepared by the author for the use of practitioners and students of medicine, as a summary only of the recent investigations and advance views touching the various sequelæ that follow in the train of these contagious disorders, and to lay before the profession the knowledge of the present day gained by the use of comparatively small doses of medicine in their treatment.

Believing in the "dualistic theory" that the origin of the exciting virus which produces the local contagious ulcer, differs from that which develops true syphilis, the terms chancroid and syphilis are used to designate these two essentially distinct conditions.

It is not intended that this little treatise shall take the place of the larger works on venereal diseases, but that it shall be a useful guide and a ready reference to the general practitioner; a synopsis of the more accurate and scientific observations lately gained in the therapeutics of these disorders.

As such it is committed to the profession trusting that humanity may be benefited by its teachings, and that homœopathy may receive the proper credit due it in the more successful treatment of these affections by attenuated medicines, which our brethren of the allopathic school are slowly and grudgingly adopting."—*Extract from Dr. Franklin's Preface.*

GROSS & DELBRIDGE, Publishers,
48 Madison St., CHICAGO.

IN PRESS.

How to Feed the Baby. By R. N. TOOKER, M. D., Professor of Diseases of Children, in the Chicago Homœopathic Medical College.

This is a little work of about one hundred and fifty pages, intended to instruct mothers in the all important matter of how, when, and what to feed their babies.

As the author says, in his introductory chapter, "It is not ntended to offer any instruction or even suggestions in the way of domestic medication. The writer is among those who believe that when a child is sick enough to need medicine, it is sick enough to need a doctor.

The work is divided into some nine chapters and an appendix, containing formulæe for the preparation of several kinds of food recommended in the body of the book. The contents are as follows:

CHAPTER I.—*Signs of Faulty Nutrition.* Changes of color of skin in illy nourished babies.—Sleep—Cry—"Does the baby grow?"—Weight of a healthy child at different periods—Height of same.

CHAPTER II.—*Peculiarities of the Digestive Organs in Infancy.*—Stomach, Liver, Pancreas.—The different digestive juices and their action on alimentary substances—Digestion of starch, of milk, of meat—Intestinal digestion.

CHAPTER III.—*Nursing.* Mothers who ought to nurse their babies—Mothers who ought not to suckle—Time of nursing—Diet of Nursing women—Wet nurses.

CHAPTER IV.—*Weaning.* When to wean—How to wean—Diet of child after weaning.

CHAPTER V.—*Partial Feeding.* Best food for partially fed baby—When to feed and when to nurse.

CHAPTER VI.—*Hand-fed Babies.* Cow's milk—Difficulty of getting sweet and fresh in cities—How to keep milk sweet—Test for pure milk—Trouble from giving baby all milk—One cow's milk—Condensed milk.

CHAPTER VII.—*Artificial Foods.*—Different kinds of cereals used in—Ridges' Food, Graham's, Horlick's Food—How to prepare—Other foods.

CHAPTER VIII.—*Adjuncts of Feeding.* Value of fresh air and exercise, bathing, sunlight, etc.

CHAPTER IX.—*How not to do it.* No crude drugs for babies—"Soothing sirups"—Paregoric, dietetic aphorisms.

All orders should be addressed to

GROSS & DELBRIDGE, Publishers,
48 Madison St., CHICAGO.

Lectures on Fevers. By J. R. KIPPAX, M D., L L. B., Professor of Principles and Practice of Medicine in the Chicago Homœopathic Medical College; Clinical Lecturer and Visiting Physician to the Cook County Hospital; Author of "Handbook of Skin Diseases," etc.

The work will comprise thirty lectures, embracing every form of Fever; their Definition, History, Etiology, Pathology, and Homœopathic treatment, making a most important and valuable addition to our literature. About 500 pages. Octavo.

LECTURE I.—**Fevers.** Introduction. Classification of Fevers. Miasmatic, or Malarial. Miasmatic-Contagious, and Contagious. The Thermometry of Fevers.

LECTURE II.—**Fevers.** Simple Continued Fever.—*Malarial Fevers.* Laws of Malarial, Miasmatic, Geographical Distribution, and Incubation.

LECTURE III.—**Intermittent Fevers**—Intermittent Fever. Definition. Synonym. Historical Notice. Etiology. Clinical History. Types of Intermittent. Morbid Anatomy. and Differential Diagnosis.

LECTURE IV.—**Intermittent Fever** (continued). Complications and Sequelæ. Prognosis. Chart of Characteristics. Prophylaxis. Treatment.

LECTURE V.—**Remittent Fever.** Definition. Synonym. Historical Notice. Etiology. Clinical History. Morbid Anatomy.

LECTURE VI.—**Remittent Fever** (continued.) Differential Diagnosis Complications, and Sequelæ. Prognosis. Chart of Characteristics. Treatment.

LECTURE VII.—**Pernicious Malarial Fever.**—Definition. Synonym. Historical Notice. Etiology, and Clinical History. Types of Pernicious Malarial Fever. Duration. Morbid Anatomy. Differential Diagnosis. Complications, and Sequelæ. Prognosis. Chart of Characteristics. Treatment. Chronic Malarial Infection.

LECTURE VIII.—**Dengue.** Definition. Synonym. Historical Survey. Etiology. Clinical History. Duration. Morbid Anatomy. Differential Diagnosis. Prognosis. Chart of Characteristics. Treatment.

LECTURE IX.—**Hay Fever.** Definition. Synonym. History and Statistics. Etiology. Clinical History. Differential Diagnosis. Prognosis. Prophylaxis. Treatment.

LECTURE X.—**Typho-Malarial Fever.**—Definition. Synonym. Historical Notice. Etiology. Types of Typho-Malarial Fever. Clinical History. Duration.

LECTURE XI.—**Typho-Malarial Fever** (continued). Morbid Anatomy. Complications and Sequelæ. Differential Diagnosis. Prognosis. Chart of Characteristics. Treatment.

LECTURE XII.—**Miasmatic-Contagious Fevers.** *Typhoid Fever.* Definition Synonym. History and Statistics. Etiology.

LECTURE XIII.—**Typhoid Fever** (continued.) Clinical History. Duration. Morbid Anatomy.

LECTURE XIV.—**Typhoid Fever** (continued.) Complications and Sequelæ. Differential Diagnosis. Prognosis. Chart of Characteristics. Treatment.

LECTURE XV.—**Yellow Fever.** Definition. Synonym History and Statistics. Etiology. Clinical History. Differential Diagnosis. Morbid Anatomy. Complications, and Sequelæ. Prognosis. Chart of Characteristics. Treatment.

The above selections from table of contents will give the reader some idea of the value of this new book. The work is now in press and will be ready about January 1st, 1883.

GROSS & DELBRIDGE, Publishers,

48 Madison St., CHICAGO.

IN PRESS.—Ready March, 1883.

The American Homœopathic Dispensatory. Designed as a Text-Book for the Physician, Pharmacist and Student. About 500 pp. octavo. Illustrated.

This important work is written in a plain and concise manner by a gentleman of large experience as a pharmacist, and who seems therefore to have fully comprehended the long felt want of a reliable and scientific pharmacopœia.

Indeed we can safely assert that this work will be to the Homœopathic School what the United States Dispensatory now is to the Allopathic School, a *desideratum*.

The American Homœopathic Dispensatory.

was conceived, born and bred as a pharmaceutical text-book, and, as such, is intended for the druggist, the student, and the physician. In brief, the contents are but a series of modern practical paragraphs, each one of which is equally important. Not in any one instance is there any attempt made to contort or re arrange the subject matter of other Homœopathic Pharmacopœias, but, the work is wholly original and replete with practical information.

It is the Book for Practical Instruction.

The volume will be an octavo of about 500 pages; printed on the best paper, and bound in the best manner. Be sure and buy no work on the subject until you have seen and examined "*The American Homœopathic Dispensatory*."

All orders should be addressed to

GROSS & DELBRIDGE, Publishers,
48 Madison St., CHICAGO.

The Physician's Condensed Account Book. An Epitomized System of Book-Keeping, avoiding the necessity of separate Journal, Day Book and Ledger, combining system, accuracy and easy reference, with a minimum of labor. 272 pages. Price, $3.50.

The book furnishes an entirely unique system of keeping books for physicians. No separate Day Book, Journal or Ledger is required. The doctor's whole month's business is spread out before him on a double page, and each patron for the month has a line all to himself. In posting the book for the month, there is a column of charges against each patient treated; another column in which that patient's unpaid balance of old account is brought forward; another column totals due, cash paid, etc. Opposite each name is a column for the patients residence, street and number, the year and the month. The system is simple and plain.

"The book is the best I ever saw. All before your eyes. Have made some collections already which were forgotten, because not seen. Every physician should have one."

CHARLES E. PINKHAM, M. D , Woodland, Cal.

Gentlemen: I have received the Physicians Condensed Account Book, and am very much pleased with it. I pronounce it a grand success. J. DEITRICK, M. D., Petrolia, Pa.

GROSS & DELBRIDGE,

Gentlemen: The Account Book came to hand all right. After a trial we can truly say that we are very much pleased with it. It is all any medical man can ask in the way of book-keeping. By using every other line we are enabled to keep a record of our prescriptions, and we thus have a complete picture of our business before us. We have no hesitation in recommending it to the busy practitioner. Yours,

Drs. DAYFOOT & MCKAY, Mt. Morris, N. Y.

GROSS & DELBRIDGE,

Gentlemen: Having used the Physician's Condensed Account Book for a year past, I am prepared to speak intelligently as to its merits, and I truly regard it as the *Ne plus ultra* of book-keeping for the busy practitioner. My accounts are always in order. It combines accuracy with condensation.

R. N. TOOKER, M. D., Chicago.

GROSS & DELBRIDGE, Publishers,

48 Madison St., CHICAGO.

Important to Physicians.

DRY TESTS FOR ALBUMIN

AND

Sugar in the Urine.

The disadvantages attendant upon the use of strong acids and alkalies in clinical examinations of the urine are so well known as not to need enumeration; the stains made by nitric acid on the clothing, its caustic action on the skin, to say nothing of the disagreeable odor evolved on boiling it with urine, are too well known to all physicians using it. The same may be said, although to a less degree, of caustic potash used in Prommers test. Dr. Clifford Mitchell has simplified urinary analysis as far as albumin and sugar are concerned by bringing to the notice of practitioners, Raabe's dry test for albumin and Pavy's dry test for sugar. In testing for these substances *no liquid* is used, save the urine itself; the chemicals are in the form of crystals and pellets one or two of which are merely dropped in to a test tube half or three-quarters full of urine, *and the test is made.* The simplicity, neatness, and rapidity with which the test for albumin and sugar can thus be made will cause these preparations to supersede all others.

Sold in a neat, covered box containing two test tubes and brush, litmus paper etc., etc., by

GROSS & DELBRIDGE.

48 Madison St., Chicago.

Price $1.00. Full directions accompany each box.

Homœopathic Label Book, for the use of Physicians and Pharmacists, containing more than thirty-five hundred gummed labels in large, clear type, and bound in a neat and substantial manner. Price 50 cents.

Sample Labels.

Belladonna.	Belladonna.	Belladonna.
Belladonna.	Belladonna.	Belladonna.
Belladonna.	Belladonna.	Belladonna.
Belladonna	Belladonna.	Belladonna.
Belladonna.	Belladonna.	Belladonna.
Belladonna.	Belladonna	Belladonna.
Belladonna.	Belladonna.	Belladonna.
Benzoic acid.	Benzoic acid.	Benzoic acid.
Benzoic acid.	Benzoic acid.	Benzoic acid.
Berberin.	Berberin.	Berberin.
Berberis vulg.	Berberis vulg.	Berberis vulg.
Bismuth met.	Bismuth met.	Bismuth met.
Bismuth nit.	Bismuth nit.	Bismuth nit.
Bismuth nit.	Bismuth nit.	Bismuth nit.
Boletus sat.	Boletus sat.	Boletus sat.

For Sale at all the Pharmacies, or sent free on receipt of price.

GROSS & DELBRIDGE, Publishers
48 Madison St., CHIC

A NEW REMEDY.

Hydrastia Restorative Tonic.

We desire to call the attention of invalids, who need a tonic without alcoholic stimulants, to the valuable remedy which we have prepared at the suggestion of many Homœopathic physicians. The basis of the Tonic is the highly valued remedy Hydrastia Canadensis or Golden Seal. The preparation is for the purpose of enriching the blood and imparting a healthy tone to the nervous system. It does this by arousing a normal appetite; stimulating digestion and assimilation, and thus aids in supplying the tissues with their proper food. It is useful in all conditions of physical debility from exhausting diseases, loss of fluids or mental depression, and will agree with the most delicate stomach.

We refer to the following testimonials:

CHICAGO, July 16, 1881.

Messrs. Gross & Delbridge:

The "*Restorative Tonic*" put up by you meets a common demand from my patients. I consider I am doing them a kindness by prescribing it, and thus preventing a resort to Quinia or the many deranging and powerful nostrums and preparations sold by druggists. I have never heard any but good reports of the effects Yours,

E. M. HALE, M. D.

CHICAGO, July 18, 1881.

Messrs. Gross & Delbridge:

Gentlemen:—It gives me pleasure to recommend your "Hydrastia Tonic." It has served my purpose in many cases, meeting a long felt want.

Respectfully yours,

JULIA HOLMES SMITH, M. D.

CHICAGO, July 25, 1881.

Gentlemen:—I have prescribed the "Hydrastia Restorative Tonic" with the best results. I regard it as a restorative of great value in all cases of debility arising from impaired nutrition. MRS. M. M. GROSS, M. D.

Palmer House.

Gentlemen:—We have had the opportunity of thoroughly testing the virtues of your "Hydrastia Restorative Tonic," and have much pleasure in according it our hearty indorsement as a "Nutrient." In almost all cases of Female Debility, Dyspepsia, Hysteria and Leucorrhœa it gives fine results. We regard it as an efficient and elegant preparation. It is but a few days since that a lady patient recently removed to Texas, wrote to us for a pint bottle of the Tonic, having derived great benefit from its use whilst in the City.

Yours Respectfully,

MRS. E. UNDERWOOD, M. D.

New Albany, Ind., W UNDERWOOD, M. D.

Put up in Pint Bottles. Price $1,00. A discount to Physicians.

PREPARED ONLY BY

GROSS & DELBRIDGE,

48 Madison Street, Chicago.

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

J53 Mitchell, Clifford.
M681 Guide in urinalysis
1882 5696

NAME | DATE DUE